EXPLANATION OF THE PLATES.

Plate XXV.

Crania of *Potamochœrus*, side view. ¼ natural size.

Fig. 1. *Potamochœrus chœropotamus dæmonis*, ♀. B.M. 92.4.24.4.
2. *P. larvatus*, ♀. From Ampitambè forest (Madagascar).
3. *P. johnstoni*, ♀. Type. B.M. 91.5.9.5.
4. *P. chœropotamus nyasæ*, ♂. B.M. 94.3.18.9.

Plate XXVI.

Crania of *Potamochœrus*, upper view. ¼ natural size.

Fig. 1. *Potamochœrus johnstoni*, ♀. Type. B.M. 91.5.9.5.
2. *P. larvatus*, ♀. (Ampitambè, Madagascar.)
3. *P. chœropotamus dæmonis*, ♀. B.M. 92.4.24.4.
4. *P. chœropotamus nyasæ*, ♂. B.M. 94.3.18.9.

April 6, 1897.

W. T. Blanford, Esq., F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of March 1897:—

The total number of registered additions to the Society's Menagerie during the month of March was 152, of which 44 were by presentation, 2 by birth, 42 by purchase, 30 were received in exchange, and 34 on deposit. The total number of departures during the same period by death and removals was 106.

Amongst the additions attention may be called to two examples of the Indian Pigmy Goose (*Nettopus coromandelianus*), presented by Frank Finn, Esq., B.A., F.Z.S., of Calcutta, on March 22nd. Many attempts have previously been made to introduce this bird into Europe, but without success; and these are the first specimens that have reached the Society's Gardens alive.

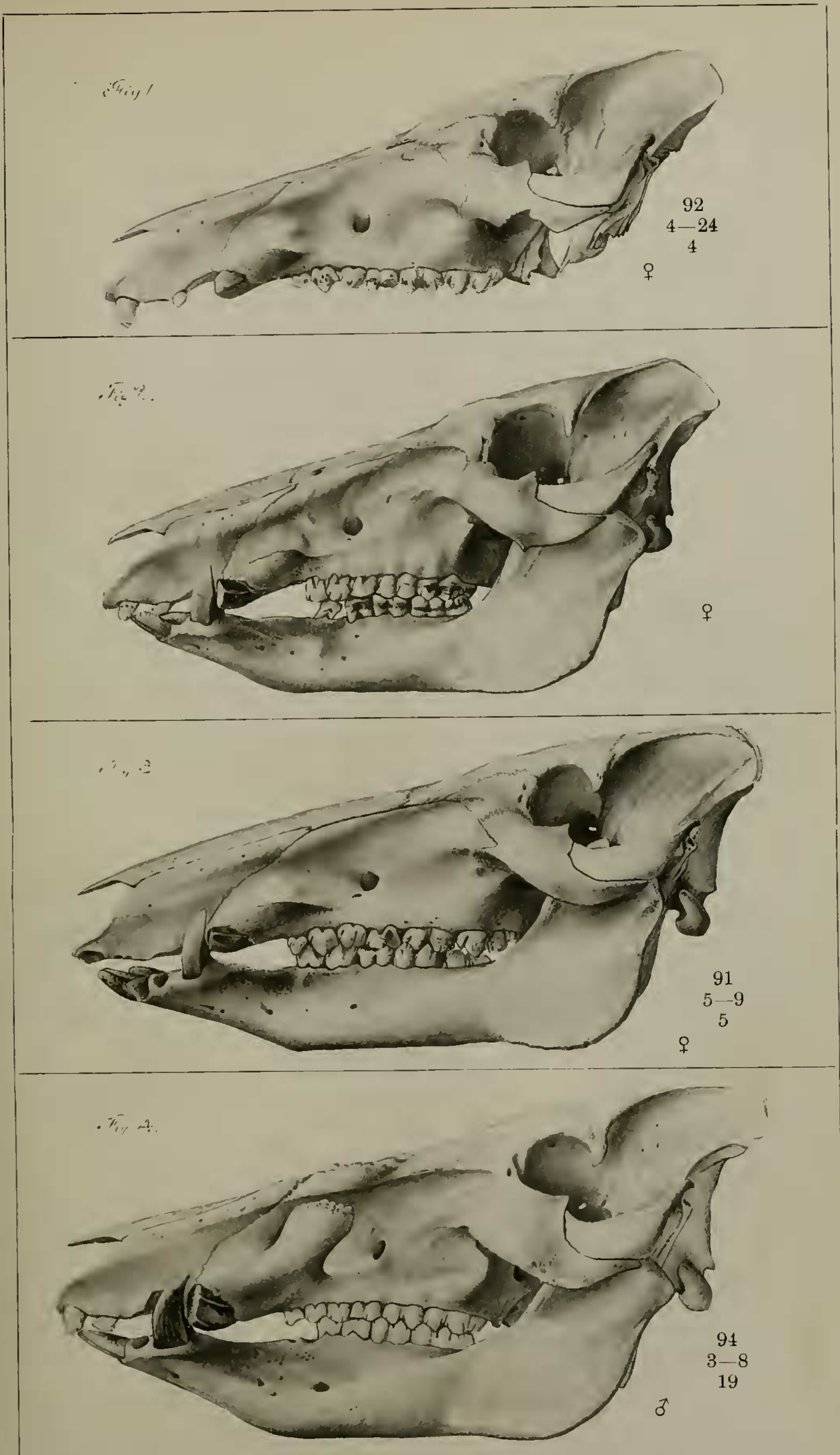
The Secretary exhibited, on behalf of Mr. A. J. Lawford Jones, a curious cinnamon-coloured variety of the Blackbird (*Turdus merula*), which had been captured near Dorking, Surrey.

The following papers were read:—

1. On the Myology of the Terrestrial Carnivora.—Part I. Muscles of the Head, Neck, and Fore-Limb. By B. C. A. Windle, M.A., M.D., D.Sc., Professor of Anatomy at Mason College, Birmingham, and F. G. Parsons, F.R.C.S., F.Z.S., F.L.S., Lecturer on Comparative Anatomy at St. Thomas's Hospital.

[Received February 11, 1897.]

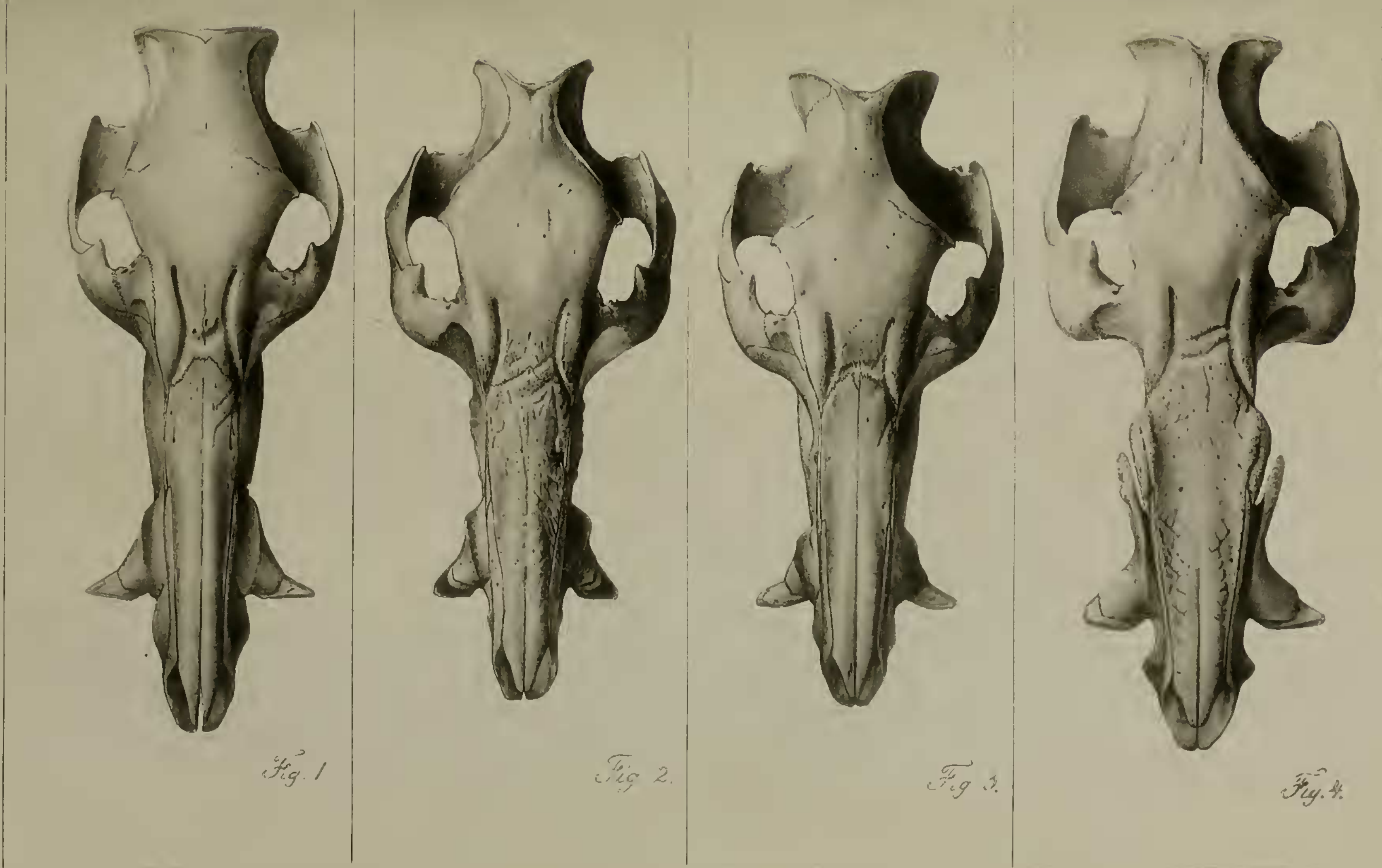
During the last four or five years a considerable number of bodies of carnivorous animals have come into our possession, partly



H. Gronvold del. *Collotype, Morgan & Kidd, Richmond, S.W.*

¼ nat. size.

Fig. 1. Potamochœrus chœropotamus dæmonis. Fig. 2. P. larvatus.
Fig. 3. P. johnstoni. Fig. 4. P. chœropotamus nyasæ.



H. Gronvold del. $\frac{1}{4}$ nat. size. Collotype, Morgan & Kidd, Richmond, S.W.

Potamochœrus johnstoni. P. larvatus. P. chœropotamus dæmonis. P. c. nyasæ.

through the generosity of this Society, partly from other sources. We have therefore thought it advisable to collaborate in working through this material and in comparing our results with the numerous published records on the myology of Carnivora which are scattered through zoological literature. We are also greatly indebted to Prof. Macalister for several unpublished records of dissections. Altogether we find that we have more or less complete accounts of 79 animals, a number which, we think, justifies us in making an attempt at a comprehensive review of the order—a review which, though it cannot be final, may indicate the present state of our knowledge of the subject, and may serve to direct the attention of future observers towards points which they might otherwise overlook. The great difficulty in a work of this kind is to avoid recording twice observations made by one observer and quoted by another, and thus giving a false idea of the frequency of variations: for instance, it is easy to find a great many statements about the muscles of the Dog and Cat scattered about, but it is often impossible to make out whether the writer really dissected the animal or is relying on the description of someone else. For this reason we have decided to err on the side of safety, and have excluded a good many statements about the originality of which we were doubtful.

With a view to prevent any confusion between the facts which we have observed ourselves and those quoted from others, we commence our paper with a numbered list of all the animals referred to. When a Roman numeral follows an animal's name it refers to the bibliography at the end of the paper; when no such numeral follows, the animal has been dissected by ourselves.

In the text, whenever an animal is mentioned, an ordinary numeral is placed after it to show which specimen in our list is referred to; when more than one numeral is present it shows that the statement holds good for more than one animal.

This first part of the paper is devoted to statements of facts; we propose to reserve all conclusions and generalizations until the whole of the muscles have been described and compared.

List of Specimens of Animals referred to.

FELIDÆ.

1. Lion (*F. leo*). Macalister (unpublished).
1*a*. Lion (*F. leo*). Cuvier & Laurillard. (V.)
2. Lion (*F. leo*). Haughton. (III.)
3. Tiger (*F. tigris*). Macalister (unpublished).
4. Leopard (*F. pardus*). Macalister (unpublished).
5. Leopard (*F. pardus*). Cuvier & Laurillard. (VI.)
6. Cat (*F. catus*). Mivart. (I.)
7. Cat (*F. catus*). Straus-Durckheim. (II.)
7*a*. Cat (*F. catus*). Meckel. (XXXIX.)
8. Caracal (*F. caracal*). Perrin. (XXIX.)
9. Cheetah (*Cynælurus jubatus*). Ross. (IV.)

Viverridæ.

10. Fossa (*Cryptoprocta ferox*).
11. Fossa (*Cryptoprocta ferox*). Beddard. (VII.)
12. Civet (*Viverra civetta*). Young. (VIII.)
13. Civet (*Viverra civetta*). Macalister. (IX.)
14. Civet (*Viverra civetta*). Devis. (X.)
15. Rasse (*Viverricula malaccensis*).
16. Blotched Genet (*Genetta tigrina*). Mivart. (XI.)

16*a*. Blotched Genet (*Genetta tigrina*).

17. Common Genet (*Genetta vulgaris*). Cuvier & Laurillard. (XII.)
18. Common Genet (*Genetta vulgaris*).
19. Palm Civet (*Paradoxurus typus*).
20. Palm Civet (*Paradoxurus typus*).
21. Palm Civet (*Paradoxurus typus*). Perrin. (XXIX.)
22. Ichneumon (*Herpestes*). Meckel. (XXXIX.)
23. Ichneumon (*Herpestes nepalensis*).
24. Ichneumon (*Herpestes griseus*).
25. Aard Wolf (*Proteles cristatus*). Watson. (XIII.)

Hyænidæ.

26. Striped Hyæna (*Hyæna striata*). Young & Robinson. (XIV.)
27. Striped Hyæna (*H. striata*). Meckel. (XXXIX.)
28. Striped Hyæna (*H. striata*). Cuvier & Laurillard. (XVI.)
29. Spotted Hyæna (*H. crocuta*). Watson & Young. (XV.)
30. Brown Hyæna (*H. brunnea*). Murie. (XVII.)

Canidæ.

31. Fox-terrier (*Canis familiaris*).
32. Irish Terrier (*C. familiaris*). Haughton. (XVIII.)
33. Greyhound (*C. familiaris*). Haughton. (XVIII.)
34. Greyhound (*C. familiaris*). Macalister (unpublished).
35. Pointer (*C. familiaris*). Macalister (unpublished).
36. Setter (*C. familiaris*). Macalister (unpublished).
37. Bull-dog (*C. familiaris*). Macalister (unpublished).
38. Dog (? var.) (*C. familiaris*). Meckel. (XXXIX.)
39. Dog (? var.) (*C. familiaris*). Cuvier & Laurillard. (XIX.)
40. Dingo (*C. dingo*). Haughton. (XVIII.)
41. Jackal (*C. aureus*). Macalister (unpublished).
42. Arctic Fox (*C. lagopus*). Macalister (unpublished).
43. Common Fox (*C. vulpes*). Dieck. (XXXVIII.)
44. Cape Dog (*Lycaon pictus*). Pagenstecher. (XL.)

Ursidæ.

45. Polar Bear (*Ursus maritimus*). Kelley. (XXIV.)
46. Polar Bear (*U. maritimus*). Meckel. (XXXIX.)
47. Brown Bear (*U. arctos*). Meckel. (XXXIX.)
48. Black Bear (*U. americanus*).
49. Black Bear (*U. americanus*). Shepherd. (XX.)

50. Black Bear (*U. americanus*). Testut. (XXIII.)
51. Black Bear (*U. americanus*). Haughton. (XXI.)
52. Black Bear (*U. americanus*). Cuvier & Laurillard. (XXII.)

PROCYONIDÆ.

53. Common Racoon (*Procyon lotor*).
54. Common Racoon (*P. lotor*). Allen. (XXVI.) No. 1.
55. Common Racoon (*P. lotor*). Allen. (XXVI.) No. 2.
56. Common Racoon (*P. lotor*). Meckel. (XXXIX.)
57. Crab-eating Racoon (*P. cancrivorus*). Windle. (XXV.)
58. White-nosed Coati (*Nasua nasica*). Mackintosh. (XXVII.)
59. Brown Coati (*Nasua fusca*). Mackintosh. (XXVII.)
60. Red Coati (*Nasua rufa*). Cuvier & Laurillard. (XXVIII.)
60 *a*. Coati (*Nasua* sp. inc.). Meckel. (XXXIX.)
61. Kinkajou (*Cercoleptes caudivolvulus*).
62. Kinkajou (*Cercoleptes caudivolvulus*). Perrin. (XXIX.)

MUSTELIDÆ.

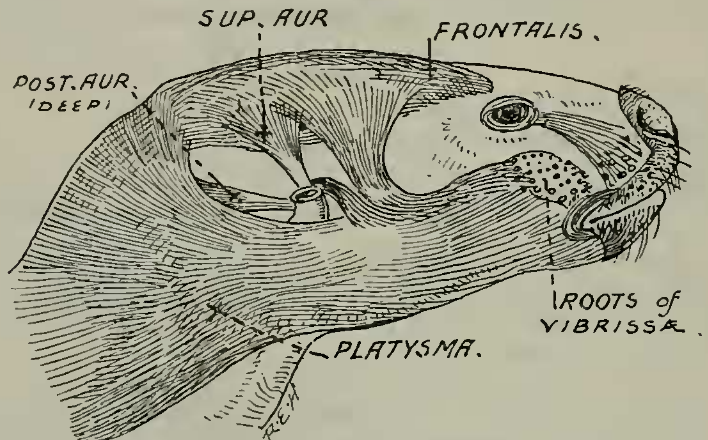
63. Grison (*Galictis vittata*).
64. Tayra (*Galictis barbara*). Macalister. (IX.)
65. Polecat (*Mustela putorius*). Alix. (XXX.)
66. Beech Marten (*Mustela foina*). Cuvier & Laurillard. (XXXI.)
67. Beech Marten (*Mustela foina*). Meckel. (XXXIX.)
68. Beech Marten (*Mustela foina*). Perrin. (XXIX.)
69. Cape Polecat (*Ictonyx zorilla*).
70. Libyan Polecat (*Ictonyx libyca*).
71. Badger (*Meles taxus*). Macalister (unpublished).
72. Badger (*Meles taxus*). Cuvier & Laurillard. (XXXIII.)
73. Badger (*Meles taxus*). Meckel. (XXXIX.)
73 *a*. Badger (*Meles taxus*). Haughton. (XXXII.)
74. Common Otter (*Lutra vulgaris*).
75. Common Otter (*Lutra vulgaris*). Lucae. (XXXVI.)
76. Common Otter (*Lutra vulgaris*). Cuvier & Laurillard. (XXXV.)
77. Common Otter (*Lutra vulgaris*). Meckel. (XXXIX.)
78. Indian Otter (*Lutra cinerea*). Macalister. (XXXVII.)
79. Common Otter (*Lutra vulgaris*). Haughton. (XXXIV.)

Muscles of the Head and Neck.

Facial Muscles.—The most superficial and at the same time the most important of the facial muscles is the platysma; this is continued backwards from the orbicularis oris and depressor muscles of the mouth towards the back of the animal's neck and covers very little of the ventral surface of the throat. It evidently corresponds more especially to that part of the platysma which in Man is called the risorius (see figs. 2 and 3, p. 375). Two muscles are partly covered by this: the first rises from the anterior part of the root of the ear and runs downwards and forwards to the deep surface of the platysma, and so reaches the angle of the mouth. In the Polecats (69, 70), where the head is a good deal elongated, this muscle, instead of coming all the way from the ear, rises from the anterior part of the zygoma just behind the orbicularis palpebrarum (see fig. 3, p. 375). As we think it an advantage, wherever possible, to use the names familiar to human anatomists, we shall speak of this as the levator anguli oris, though it only comes from the zygoma in certain cases.

The second muscle which is covered by the platysma is the sterno-facialis or sphincter colli: this rises from the back of the root of the ear and meets its fellow of the opposite side in the mid-ventral line of the neck, covering in its course the parotid gland (see fig. 2, p. 375). In the Felidæ this muscle is strongly marked

Fig. 1.



Face-muscles of *Lutra vulgaris*.

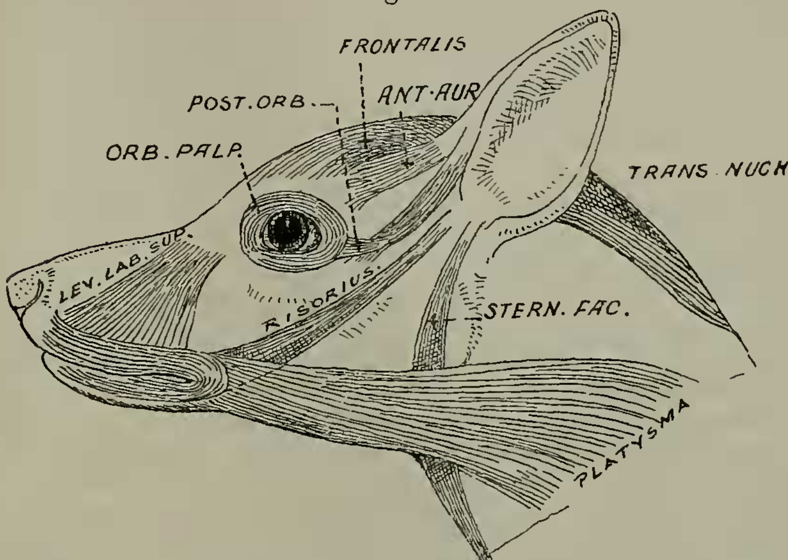
and the anterior part comes from the fascia over the masseter. In no case that we have seen does it reach, as in the rodents, to the sternum[1] (XLI.). The orbicularis palpebrarum is not very strongly marked, from its posterior edge two or three bundles of muscular fibres run backwards and act as retractors of the angle of the eye; these are best seen in the Canidæ. The levator labii superioris is always well marked and passes from the anterior angle of the eye to the upper lip, deep to it is a plane of muscle acting on the nose. The orbicularis oris is well marked. The occipito-frontalis is a plane of fibres which covers the scalp; the lateral part of the frontalis is attached posteriorly to the ear and forms the anterior auricular muscle, while the lateral part of the occipitalis is attached anteriorly to the ear and is thickened to form the transversus nuchæ; deep to this are one or two posterior auricular muscles.

It will thus be seen that the main muscles of the face are disposed in such a way as to draw the soft parts of the lips and nose clear of the teeth, and also to lay back the ears; the sphincter

[1] In *Bathyergus* the sterno-facialis and sphincter colli are coexistent (XLII.).

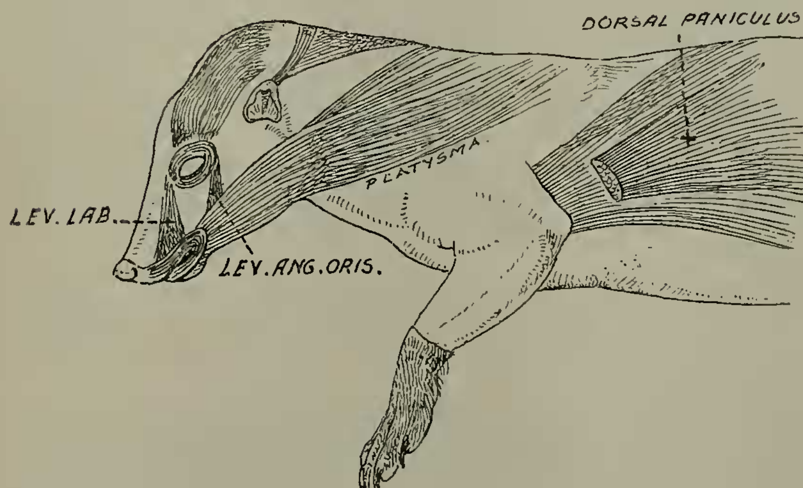
colli would tend to draw the skin of the neck forwards and throw it into wrinkles, possibly with a protective object in case of the animal being seized by the throat. We have not sufficient material to contrast the different families of Carnivora so far as their facial

Fig. 2.



Face-muscles of *Canis familiaris*
(*For* Risorius *read* Zygomaticus.)

Fig. 3.



Face-muscles and panniculus of *Ictonyx libyca.*

muscles go with any certainty; but from what we have observed we should say that the Felidæ excel in the development of the sphincter colli, the Canidæ in that of the risorius and zygomaticus and in the greater differentiation of the muscular planes giving an increased power of expression. In *C. vulpes* (43), Dieck (XXXVIII.) describes almost as many muscles as in the human face, but speaking generally his description agrees with our own. The other families seem to resemble the Canidæ more than the Felidæ, especially in the lesser development of the sphincter colli. In *Nasua* (60) there is a strong levator alæ nasi divided into two bundles, which give the great mobility to that creature's snout.

Temporal.—The temporal muscle rises from the side of the skull as high as the sagittal crest when this is present and as far back as the occipital curved line. There is always a tendinous plane in the substance of the muscle which divides it into two fleshy layers and to which both these layers are attached. In *Ictonyx* (70) and *Lutra* (74) it was noticed that this plane was only present in the anterior part of the muscle. As a rule the muscles of opposite sides meet at the sagittal crest, but in *Ictonyx* (70) and *Canis* (31) they are separated by a slight interval, while in *Lutra* (74, 75), owing to the breadth of the skull, a considerable space divides them. In *Viverra civetta*, Young (12) states that the temporal is with difficulty separable from the masseter. Watson (XV.) and Young (XIV.) have drawn attention to the great development of the masticatory muscles in the Hyænidæ.

Masseter.—This muscle is always very strong. It rises from the whole length of the zygomatic arch as well as from the deep surface of the temporal fascia above the arch. As a rule the muscle can easily be separated into a superficial and a deeper layer; the former of these rises from the outer surface of the malar bone and from the anterior half of the zygoma, its fibres run downward and backward to be inserted into the lower border of the mandible near the angular process, where they blend slightly with those of the internal pterygoid, they are also inserted into the lower part of the external surface of the ramus. The deep part rises from the whole length of the zygomatic arch, its fibres converging on to the upper part of the surface of the ramus of the mandible. In *Procyon lotor* (53) it was noticed that this deep part was again easily separable into two layers, superficial and deep, an arrangement which, however, we have not seen in any other animal.

Buccinator.—This muscle is fairly well developed in all Carnivora, but shows nothing of special interest. It is attached to the alveolar margins of both jaws and blends anteriorly with the orbicularis oris.

Pterygoids.—The external and internal pterygoids are with difficulty separable in Carnivora; the former rises from the external surface of the palatine bone and is inserted into the upper part of the internal surface of the ramus of the mandible. The internal pterygoid rises below and internal to the last, and is inserted into the mandible near its angle and into the stylo-mandibular ligament.

Digastric.—This, in spite of its name, is really a monogastric muscle in the Carnivora; it is thick and strong and rises from the paroccipital process and often from the contiguous paramastoid and bulla tympani; it is inserted into the body of the lower jaw midway between the angle and symphysis (see fig. 4, p. 378). It has no connexion with the hyoid bone, and the only evidence of a separation into two bellies is a feeble line of tendon about the middle, which is quite superficial and does not extend into the interior of the muscle. In some cases, e.g. *Civetta* (12), *Genetta* (18), *Ursus* (52), *Nasua* (60), and *Ictonyx* (70), no tendinous intersection at all was noticed. In spite of its appearance the anterior part of the muscle is supplied by the mylo-hyoid, and the posterior by the facial nerve.

Mylo-hyoid.—The mylo-hyoid has the same attachments as in Man (see fig. 4, p. 378). It usually extends as far forwards as the symphysis menti, but in *Canis* (31), *Hyæna striata* (28), and *H. crocuta* (29) it ends anteriorly in an angle, the convexity of which is towards, but does not reach the symphysis. In *Procyon lotor* (53) the arrangement is the same as in the Canidæ and Hyænidæ, but *Nasua rufa* (60) agrees with the rest of the Carnivora in this respect.

Genio-hyoid and Genio-hyoglossus.—Nothing remarkable was noticed about these muscles. They have the usual human attachments.

Stylo-hyoid.—The typical carnivorous stylo-hyoid seems to consist of two parts, superficial and deep: the former is a small slip which rises from near the root of the paroccipital process and passes over the digastric, to reach the hyoid bone; the latter rises deep to the origin of the digastric and is usually inserted into the epihyal element of the hyoid arch, it is sometimes spoken of as the masto-hyoid (see fig. 4, p. 378). This arrangement was noticed in *F. catus* (7), *Genetta* (17, 18), *Herpestes* (24), *Cryptoprocta* (10), *Canis* (39), and *Cercoleptes* (61).

In the Mustelidæ the superficial part was not seen, but unless looked for it may easily escape notice, and this is also the case with the deep part.

It is possible that the human arrangement of the stylo-hyoid, in which the digastric tendon passes through it, may be explained by looking upon the human muscle as a combination of the stylo-hyoid and masto-hyoid of the Carnivora.

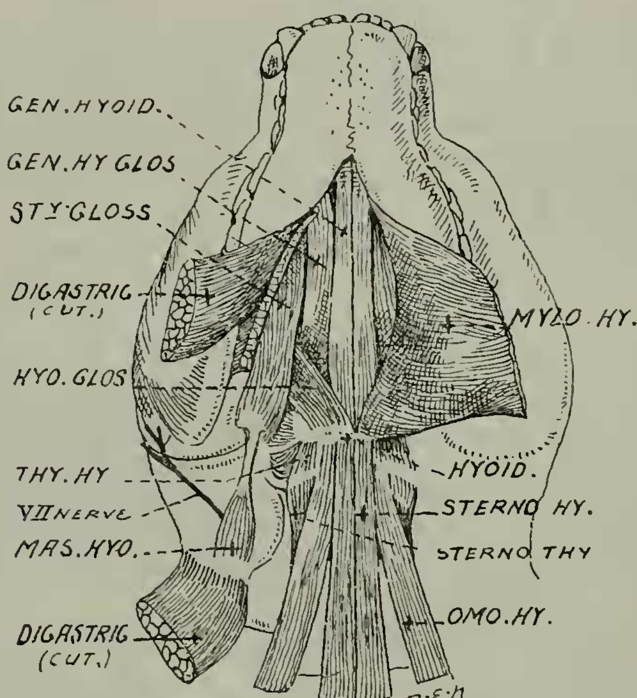
Styloglossus.—This is always present and is by far the best developed of all the styloid muscles in Carnivora; it rises from the stylo- or epi-hyal elements of the hyoid arch, and passes to the superficial side of the hyoglossus as in Man (see fig. 4, p. 378).

Cerato-hyoid.—This muscle is described by Straus-Durckheim in the Cat (II.) and by Alix in the Polecat (XXX.); it passes from the thyro-hyal to the cerato-hyal elements of the hyoid apparatus. We have failed to notice it in any of the animals which we have dissected, while in *Genetta* (18) and *Herpestes* (24) we specially looked for it without success.

Stylo-pharyngeus.—The stylo-pharyngeus is always present though small; it rises from the deep surface of the stylo-hyal and passes to the pharynx.

Sterno-mastoid.—This muscle rises from the anterior part of the sternum and is inserted into the occipital curved line, the paramastoid, and sometimes the paroccipital process; it may be more or less fused with the cleido-mastoid at its insertion. Among the Viverridæ Meckel (XXXIX.) has noticed that the sterno-mastoid consists of two layers, superficial and deep, in *Herpestes* (22), and we have confirmed his observation in *H. nepalensis* (23) and *griseus* (24). In *Genetta vulgaris* (18) the same arrangement exists, but it was not noticed in *Paradoxurus typus* (19, 20) or

Fig. 4.



Throat-muscles of *Lutra vulgaris*.

Cryptoprocta (10); and neither Young (VIII.) nor Macalister (IX.) make any mention of a bilaminar condition in *Viverra* (12, 13). Cuvier and Laurillard (XII.) figure the trapezius as rising from the sternum in the Genet, and Lucae (XXXVI.) does the same in the Otter, so that probably the explanation of the bilaminar sterno-mastoid is that the superficial layer is really trapezius, and that in those animals in which the muscle is unilaminar the sterno-mastoid and trapezius have completely fused. In many cases the sterno-mastoid is fused with its fellow of the opposite side near its origin in the posterior part of the neck; this seems to occur most often among the Hyænidæ, Canidæ, Ursidæ, Procyonidæ, and Mustelidæ, though it does not always happen in these families—for instance, the two sterno-mastoids were fused in the posterior third of the neck in *Ursus maritimus* (45), in two specimens of *U. americanus* (50, 52), in *Procyon lotor* (53), in four specimens of *Lutra vulgaris* (74, 75, 77, 79), and in Macalister's specimen of *Viverra civetta* (IX.), while in one specimen of *Ursus americanus* (49), in *Nasua rufa* (60), in *Cercoleptes* (61), in *Ictonyx libyca* (70), and in Young's specimen of *Viverra civetta* (VIII.) they were separate. In no animal belonging to the Felidæ[1] have we found any fusion between the opposite sterno-mastoids, and the same applies to the Viverridæ with the exception of one Civet (13), Genet (18), and *Cryptoprocta* (10).

In many animals, e. g. *Procyon lotor* (53), *Ursus maritimus* (45), *U. americanus* (49), *Lutra* (74), and *Herpestes* (24), some of the dorsal fibres of the sterno-mastoid run forward and upward to join the contiguous cephalo-humeral.

In *Hyæna striata* (26, 27, 28), *H. crocuta* (29), and *H. brunnea* (30) the muscle is divided into an inner and an outer portion, the former going to the paramastoid process, the latter to the occipital ridge. This arrangement may therefore be taken as typical of the Hyænidæ, and it is interesting to notice that in *Proteles* (25) the same arrangement was found.

Cleido-mastoid.—This muscle, as has already been pointed out, is usually distinct from the sterno-mastoid though it may be fused with it at its insertion. It rises from the rudimentary clavicle or, when that is absent, from the tendinous intersection in the cephalo-humeral muscle; it passes forwards to be inserted into the par-occipital process deep to the insertion of the sterno-mastoid. The spinal accessory (XIth) nerve seems to have a most constant relation to this muscle, first piercing it and then running between it and the sterno-mastoid to the trapezius.

In *Cercoleptes* (61) the nerve passed entirely between the two muscles, but this was the only exception with which we met. It is interesting to contrast the behaviour of the spinal accessory in the Carnivora and Rodentia (XLI.): in the former it pierces the cleido-mastoid, in the latter it passes deep to that muscle.

Sterno-hyoid, Sterno-thyroid, and Thyro-hyoid.—Owing to the narrowness of the sternum, the two first-named muscles rise largely from the first rib. In *Proteles*, Watson (XIII.) describes the two sterno-hyoid muscles of opposite sides as being fused in the middle line, but this was not noticed in the Hyænidæ or indeed in any other animal. In *Lutra cinerea*, Macalister (XXXVII.) describes a tendinous intersection in both the sterno-hyoid and sterno-thyroid; we found the same thing in the Dog (31), though in that animal the sterno-hyoid and thyroid were fused on the caudal side of the intersection. Devis's specimen of *Viverra civetta* (X.) seems to have shown a similar arrangement. In the other animals examined the muscles had the usual human attachments.

Omo-hyoid.—When this muscle is present it has the usual

[1] In *F. catus* (7) and *F. leo* (1*a*) we cannot satisfy ourselves whether a fusion does or does not exist.

attachments to the hyoid bone and anterior border of the scapula, there is no central tendon as in Man, and in no case was any connection with the clavicle noticed. Among the Felidæ it is apparently never present; it is certainly absent in *F. leo* (1, 1*a*), *F. tigris* (3), *F. pardus* (4), *F. catus* (6, 7), and *F. caracal* (8), while Ross makes no mention of it in *Cynælurus jubatus* (IV.). Among the Viverridæ it is absent in *Cryptoprocta* (10), in *Viverra civetta* (12, 13, 14), in *V. malaccensis* (15), in *Genetta* (17, 18), and in *Herpestes* (23, 24). Three specimens of *Paradoxurus typus* were examined (19, 20, 21), in one of which (19) a slender omo-hyoid was found though it was absent in the others. In *Proteles* (25) it is absent. Among the Hyænidæ it was found by Meckel in *H. striata* (XXXIX.), but was absent in two other specimens (26, 28); it is also wanting in *H. crocuta* (29). In the Canidæ it was absent in three Dogs dissected by Macalister (35, 36, & 41), and in one dissected by ourselves (31). Testut (XXIII.) also describes it as wanting in the Dog. In the other Canidæ of which we have records, no mention is made of it. In the Ursidæ it is present in *U. maritimus* (45) and in *U. americanus* (48, 49, 50). In the Procyonidæ it was not seen in *P. lotor* (53) or *Nasua* (58, 60, XXIII.), but was present in two specimens of *Cercoleptes* (61, 62). In the Mustelidæ it was found in *Galictis vittata* (63), *Ictonyx zorilla* (69), and *I. libyca* (70), feebly developed in *Meles* (71) and *Mustela foina* (68), well developed in two specimens of *Lutra vulgaris* (74, 79) (see fig. 4, p. 378) and in *Lutra cinerea* (78). On the other hand, it is absent in *Galictis barbara* (64).

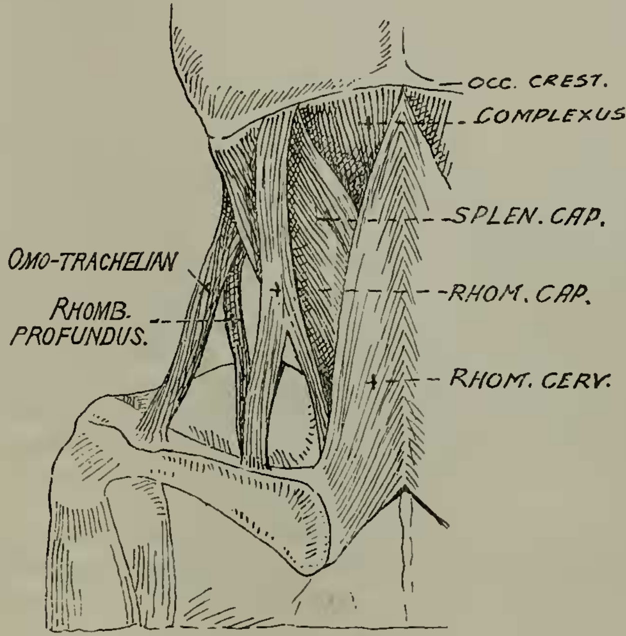
From previous experience of this muscle we are inclined to lay a good deal of stress on its classificatory value; this opinion our study of the Carnivora confirms, since its presence is almost confined to the Ursidæ and Mustelidæ, though it occasionally occurs in other families.

Omo-trachelian.—This muscle is most constant in the Carnivora; it always rises from the transverse process of the atlas and runs backwards to be inserted into the acromion process of the scapula close to the metacromial tubercle. In its course it is pierced by several of the cervical nerves from which it receives its supply. It always appears on the surface between the cervical (cephalo-humeral) and anterior thoracic portions of the trapezius, and hence is often described as piercing that muscle. It was found in every recorded dissection of Carnivora except in Young's specimen of *Viverra civetta* (VIII.); this, however, was evidently abnormal, since Devis (X.), Macalister (IX.), and Meckel (XXXIX.) found it present in that animal. It will be readily understood that this is the same muscle as the trachelo-acromial, acromio-atlantal, and levator claviculæ [1] of other authors. After considerable thought we have preferred the term "omo-trachelian" as giving the best description of the muscle throughout the Mammalia (see fig. 5, p. 381).

[1] Windle has used "levator claviculæ" for the cleido-mastoid.

Rhomboideus profundus (Trachelo-scapular, Levator scapulæ minor).—This has been described by Macalister (XXXVII.) as a lutrine muscle, but our own observations make us regard it as one of the most characteristic features of the whole of the Mustelidæ. It occurs in *Galictis vittata* (63), *Galictis barbara* (64), *Mustela putorius* (65), *Ictonyx zorilla* (69), *Ictonyx libyca* (70), *Meles taxus* (71, 72), *Lutra vulgaris* (74, 75, 79), and *Lutra cinerea* (78).

Fig. 5.



Neck-muscles of *Ictonyx libyca*.

Outside the Mustelidæ we only find it in two specimens of *Cercoleptes* (61, 62), which is of increased interest when we recall the evidence of the omo-hyoid in that animal.

The origin is from the transverse process of the atlas, the insertion into the root of the scapular spine. In many cases the muscle has been described either as part of the rhomboideus capitis or of the acromio-trachelian, since it is connected with the latter at its origin and with the former at its insertion. It is supplied by the cervical nerves (see fig. 5).

Rectus capitis ventralis (*anticus*) *major* and *minor*.—Both these muscles have the same attachments as in Man, the major coming from 3rd, 4th, 5th, and 6th cervical transverse processes, and the minor from the ventral arch of the atlas; they are both inserted into the basioccipital.

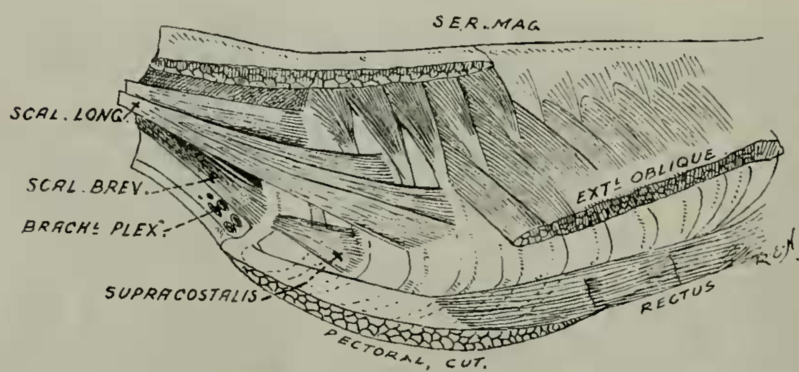
Longus colli.—The longus colli consists chiefly of the anterior and posterior oblique parts: the latter rises from the anterior thoracic centra as far back as the 5th or 6th, and is inserted into the transverse processes of the posterior cervical vertebræ; the former rises from the mid-cervical transverse processes, and is inserted into the ventral arch of the atlas as well as into the centrum of the second and sometimes the third cervical vertebra.

Scalenus ventralis (Scalenus anticus).—If by scalenus anticus we understand a muscle which passes from the ventral side of the cervical transverse processes to the first rib, ventral to the subclavian artery and brachial plexus, that muscle is very rare in the Carnivora. This is borne out by Gilis's researches (XLIII.); he says that the plexus passes anterior (ventral) to all the scalenes in Carnivora. Straus-Durckheim thinks that in the Cat (II.) the scalenus anticus has become fused with the rectus capitus anticus major, and describes it under the name of "Isoscèle." Alix (XXX.) says that it is represented in *Mustela putorius* by some fibres which are ventral to the transverse processes and are separated from the rest of the scalene mass by the nerves. We agree with Alix that nothing should be looked upon as scalenus anticus which is not ventral to the brachial plexus. In *Viverra civetta* both Macalister (IX.) and Young (VIII.) describe three scalenes; Devis (X.) also speaks of a scalenus anticus in this animal, but in his case the muscle was dorsal to the nerves.

Murie (XVII.) speaks of a scalenus anticus in *Hyæna brunnea*, but we think that it must have been a part of what we term scalenus longus, since it was attached to the 4th and 5th ribs and no mention is made of its relation to the brachial plexus. In no other carnivorous animal is there any mention of a scalenus anticus.

Scalenus longus and *brevis*.—These muscles are always present. The former rises from four or five cervical transverse processes but never reaches the first; it is inserted into the outer surfaces

Fig. 6.



Scalene muscles of *Canis familiaris*.

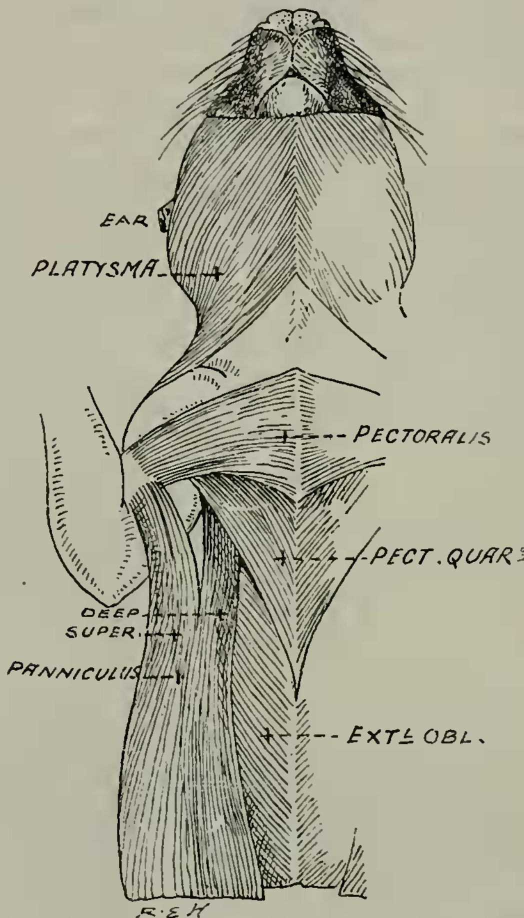
of 3, 4, or 5 ribs, beginning at the 3rd or 4th. In *Cercoleptes* (61), however, it is very well developed and is inserted from the 3rd to the 8th rib. At its insertion the muscle interdigitates with the serratus magnus and its ventral fibres reach farthest back. The scalenus brevis lies ventral to the longus and rises from the 5th and 6th cervical transverse processes, and is inserted into the first rib dorsal to the brachial plexus. In *Procyon* (53) it rises from the 3rd, 4th, and 5th vertebræ, some of its fibres being continued into the supracostalis and a few into the rectus abdominis. As the names scalenus anticus, medius, and posticus give a wrong idea of the position of these muscles in quadruped animals, we have ventured to substitute those of ventralis, brevis, and longus, more especially as we are not quite convinced that the longus corresponds entirely to the human posticus (see fig. 6, p. 382).

Muscles of the Dorsum of the Neck.—These muscles we find it more convenient to reserve until we deal with those of the trunk.

Muscles of the Anterior Extremity—Pectoral Muscles.

It is doubtful whether any satisfactory division into pectoralis major and minor is possible in the Carnivora. Young, in his description of *Viverra civetta*, says that "the pectoralis minor is wanting as usual in Carnivora" (VIII.). On the other hand, Shepherd and Testut (XXIII.) describe a definite pectoralis minor in the Black Bear (XX.). Occasionally some of the deeper fibres of the mass are inserted into the region of the coracoid process and shoulder-joint, but they are not constant even in different specimens of the same animal. As a rule four fairly distinct parts may be distinguished, and the most satisfactory mode of description seems to be to take an animal like the Racoon, which occupies an intermediate position in the Order, as a type and to notice the chief differences in other animals. In *Procyon lotor* (53), then, one portion (α) rises from the anterior half of the sternum and is inserted into the pectoral ridge in the middle two-fourths of the humerus, the fibres running transversely (this is Windle's Superficial Manubrial factor) (XLVII.). Another part (β) comes from the anterior quarter of the sternum, deep to the last, and is inserted into the humerus from the great tuberosity to the middle; the fibres of this part run forward and outward (Windle's Deep Manubrial) (XLVII.). The third part (γ) rises from the middle of the sternum to the sterno-xiphoid articulation; it is inserted deep to the last into the second quarter of the humerus and is joined on its deep surface by the abdominal and dorsal panniculus, with which it is more or less continuous. This part represents all that there is of the abdominal pectoral or pectoralis quartus, and corresponds to Windle's Superficial Gladiolar (XLVII.). The fourth part (δ) may possibly represent the pectoralis minor; it is the deepest layer of all and rises from the middle two-fourths of the sternum, running obliquely forward and outward to the head of the humerus and capsule of the shoulder (Windle's Costal factor) (XLVII.). It will be noticed that each of these last three layers is deeper than the one before it at its insertion. The proportions and amount of distinctness of the different parts of the pectoral vary infinitely and are seldom alike in two specimens of the same animal; still, so far as our observations go, the four-layered muscle is the most generalized type and corresponds to the human three-layered pectoralis major and the pectoralis minor. The above description corresponds as closely as can be expected with Allen's *Procyon lotor* (XXVI.). *Procyon cancrivorus* (57) agrees with *P. lotor* except that β is inserted largely into the shoulder capsule, while δ was not distinguished. The Mustelidæ resemble

Fig. 7.



Pectoral muscles and panniculus of *Lutra vulgaris*.

the Procyonidæ in the feeble development of the pectoralis quartus (see fig. 7); in some animals, however, e. g. *Proteles* (25), this part is much more marked, rising from a considerable distance back along the linea alba and being connected by the panniculus to the latissimus dorsi in such a manner that the floor of the axilla is quite closed in by muscular fibres. In the Hyænidæ the muscle is very strong and is inserted into the whole length of the humerus: moreover it does not appear to be as broken up as in other Carnivora. In *Herpestes griseus* (24) some of the deeper fibres of the pectoral were continuous with the supraspinatus.

Trapezius.—The first part of the trapezius (clavo-cucullaris of Straus-Durckheim) is continuous with the clavicular part of the deltoid, forming the cephalo-humeral muscle. It rises from the curved line of the occiput and from the ligamentum nuchæ and is usually well developed in Carnivora, especially in the Hyænidæ. When it reaches the region of the rudimentary clavicle there is usually a tendinous intersection marking the line of demarcation between the trapezial and deltoid elements of the muscle; at this point it is usually joined by a part or the whole of the cleido-mastoid muscle. In some cases, e. g. *Procyon lotor* (53) and *Lutra vulgaris* (74), the clavicle is fairly developed, and in these only a few fibres are attached to the bone which lies deep to the aforesaid tendinous intersection[1]. Besides the union with the cleido-mastoid at the intersection, slips are often given to or received from the sterno-mastoid; this is most marked in *Lutra* (74), in which the two muscles are largely fused, and also in *Ictonyx* (70). The second part of the trapezius (acromio-cucullaris) is very constant; it rises from the ligamentum nuchæ and anterior thoracic spines and is inserted into the anterior lip of the spine of the scapula. At its insertion it is in close contact with the acromio-trachelian, and in *Viverricula malaccensis* (15) and to a less extent in *Canis familiaris* (31) the two muscles are fused here. In *Ictonyx zorilla* (69), *I. lybica* (70), *Nasua* (58), and *Cercoleptes* (61, 62) the posterior part of the origin of the acromio-cucullaris has no attachment to the thoracic spines, but is united to the muscle of the opposite side by a tendinous junction. The third part of the trapezius (dorso-cucullaris) rises from the posterior thoracic spines and is inserted into the base of the spine of the scapula. In *Cynælurus* (9) the second part, according to Ross, rose from the ligamentum nuchæ and 7th cervical spine, while the third part came from the anterior six thoracic spines. In some cases—e. g. *Genetta vulgaris* (18), *G. tigrina* (16 *a*), *Hyæna striata* (26), *Procyon lotor* (53), *Galictis vittata* (63), *Ictonyx zorilla* (69), *I. lybica* (70), and *Lutra vulgaris* (74)—the third is separated from the second part by a fibrous interval; in other cases the two parts are in close contact: though the arrangement does not seem to depend in any way on the relationship of the various animals, since *Procyon lotor* (53) has a separation, while in *P. cancrivorus* (57) the two parts are continuous. It may be noticed that in all Carnivora the second and third parts of the trapezius are feebly developed in comparison with the first; this is true even of the Hyænidæ, in which the neck and shoulder muscles are so very powerful.

Latissimus dorsi.—The latissimus dorsi rises from a large number

[1] The development of the clavicle seems to vary a good deal individually; we found it well marked in *Lutra vulgaris*, but Macalister did not notice it in *Lutra cinerea*. Perrin (XXIX.) found it in *Cercoleptes*, but in our specimen there was no trace. Possibly age is the explanation.

of the posterior thoracic spines, usually from the 4th or 5th to the last, from the lumbar aponeurosis, and sometimes from the last three ribs. No muscular fibres can be traced to the ilium. At its insertion it usually divides into two layers, the anterior of which unites with the dorso-lateral panniculus to be inserted deep to the pectoral into the pectoral ridge of the humerus; while the deep is more or less united with the tendon of the teres major, though it is seldom twisted round that tendon as it is in the Rodents and in Man. These two parts enclose the biceps. In *Cynælurus* (9), *Procyon* (53, 54), *Mustela putorius* (65), and *Lutra* (74) it rises from the last three ribs; in *Canis* (31) from the last two; in *Viverra civetta* (12), *Genetta* (18), *Proteles* (25), *Hyæna crocuta* (29), and *H. brunnea* (30) it has no attachment to the ribs. In the other animals, unfortunately, no record has been kept as to whether it rose from ribs or not. *Procyon cancrivorus* (57) is remarkable for having the muscle divided into an anterior and posterior part; the former, which is the larger, joins the teres major and gives off the dorso-epitrochlearis, while the latter joins the dorso-humeral panniculus and is inserted with it deep to the pectoral.

Dorso-epitrochlearis.—This muscle shows frequent variations in its size and attachments; its usual origin, as in most other animals, is from the latissimus dorsi just before the latter becomes tendinous; it then runs down the inner side of the triceps to be inserted into the inner side of the olecranon process as well as into the fascia of the forearm (see fig. 8, p. 390). It is supplied by the musculo-spiral nerve. In the Cat, Mivart (I.) describes two muscles which he calls external and internal, the former rising from the spine of the scapula, the latter from the surface of the latissimus dorsi; these unite before their insertion. Straus-Durckheim, in his work on the Cat (II.), only records the internal of these. In one specimen of *Paradoxurus* (19) the muscle rose from a sling over the axillary vessels reaching from the latissimus dorsi to the biceps. In *Ursus americanus* Shepherd (XX.) describes it as rising from the axillary border of the scapula as well as from the surface of the latissimus, and says that it receives slips from the panniculus and teres major. Macalister describes two muscles in *Galictis barbara* (IX.), but one of them is evidently a structure to which we shall have to call attention under the head of the triceps.

Rhomboids.—Instead of the rhomboideus major and minor of human anatomy we find in the Carnivora one plane of muscle rising from the curved line of the occipital bone and the ligamentum nuchæ, the rhomboideus anterior, and another rising from the spines of the anterior thoracic vertebræ, which it would be convenient to speak of as the rhomdoideus posterior. The insertion is into the vertebral border of the scapula. Occasionally the posterior edge of the r. anterior is continuous with the anterior edge of the posterior, but more often there is a distinct interval between them. It is usual for many writers to speak of only that part of the muscle which is attached to the skull as a rhomboideus capitis; consequently when they state that this is absent the muscle may still rise from the whole length of the ligamentum nuchæ. Among the Felidæ the rhomboideus anterior is always present; this is the case in *F. leo* (1 *a*), *F. tigris* (3), *F. pardus* (4), *F. catus* (6), and *Cynælurus* (9). The Viverridæ are remarkable for the frequence with which the rhomboid sheet fails to reach the skull, due probably to the great distance which there is between the head and the shoulder-blades in many of these animals. In *Cryptoprocta* (10), *Viverra civetta* (12, 13, 14), *Viverricula malaccensis* (15), *Genetta tigrina* (16), *Genetta vulgaris* (18), and *Paradoxurus typus* (19) the rhomdoideus anterior never reached further forward than the level of the spine of the axis; another specimen of *Paradoxurus* (20) showed a fascial continuation of the muscle up to the occiput, while in *Herpestes nepalensis* (23) and *Herpestes griseus* (24) a definite occipital origin was noticed. *Proteles* (25) has no occipital origin for its rhomboids. Among the Hyænidæ the occipital origin was found in *H. striata* by Meckel (27), but not by Young (26) or Cuvier (28); it is also wanting in *H. crocuta* (29).

In the Canidæ there is an occipital origin in *Canis familiaris* (31, 32, 33, 37, 39) and *C. aureus* (41).

Among the Ursidæ the rhomboideus anterior is well developed and comes from the skull in *U. maritimus* (45), in two specimens of *U. americanus* (48, 52), and in *U. arctos* (47). In two other specimens of *U. americanus* (49, 50) the occipital portion was absent.

Among the Procyonidæ the occipital origin is well marked and the whole muscle forms one continuous sheet in *Procyon* (53, 54, 55, 56, 57), *Nasua* (58, 60, XXXIX.), and *Cercoleptes* (61).

In the Mustelidæ the portion of the rhomboid which rises from the occiput is always present and usually is a separate slip (see fig. 5, p. 381); this is the case in *Galictis vittata* (63), *Galictis barbara* (64), *Mustela putorius* (65), *Mustela foina* (66, 67), *Ictonyx zorilla* (69), *Ictonyx lybica* (70), *Meles taxus* (71, 72, 73), *Lutra vulgaris* (74, 79), and *Lutra cinerea* (78).

It is interesting to note that these Mustelidæ in which the gap between the occipital and cervical portions of the rhomboid sheet is so constant are equally remarkable for the constant presence of the rhomboideus profundus muscle. This muscle, as has already been stated, is fused with the rhomboid at its insertion, and by many authors is described as part of the rhomboid. We cannot help throwing out the suggestion, though we have no direct proof, that the gap in these animals between the occipital and nuchal portions of the muscle is caused by a sinking down of some of the fibres to acquire a new origin from the transverse process of the atlas, so that the rhomboideus profundus is a displaced portion of the rhomboid sheet.

To sum up, the rhomboid always seems to have an occipital origin in the Felidæ, Canidæ, Procyonidæ, and Mustelidæ. In the Viverridæ and Hyænidæ the occipital origin is the exception.

In the Ursidæ it is more often present than not. In the Mustelidæ it is not only present but is quite a separate slip.

Subclavius.—This is a very small muscle rising from the inner end of the first rib and inserted into the spicular clavicle. We have only records of it in *Viverra civetta* (12) and *Genetta* (16, 18). It never seems to occur outside the Viverridæ, though from its insignificance it might easily be overlooked. The claviculo-scapularis, which is such a distinguishing feature of Hystricomorphine Rodents (XLI.), is never found in Carnivora.

Levator anguli scapulæ and *Serratus magnus.*—These two muscles, as in Rodents, form one continuous plane rising from a large number of the posterior tubercles of the cervical transverse processes and from a large number of the anterior ribs (see fig. 6, p. 382). The latter origins interdigitate with the scalenus longus and the external oblique. Although the muscle forms one sheet it is well to emphasize the distinction between the two parts, since the levator anguli scapulæ is supplied by the cervical nerves and the serratus magnus by the posterior thoracic, or nerve of Bell. Meckel (XXXIX.) speaks of the levator anguli scapulæ as a separate muscle coming from the atlas in the Dog, Badger, Otter, and Marten. In the Dog we have no other records of any origin from the atlas and regard Meckel's specimen as a variation, but in the other three animals that which he describes as the levator anguli scapulæ is undoubtedly the rhomboideus profundus. The insertion of the combined muscles is into the dorsal or vertebral part of the subscapular fossa of the scapula, the attachment being much more strongly marked anteriorly than posteriorly.

The following table gives the exact origins in various animals:—

Felis leo (1 *a*)	2–7 C. V.	1–9 ribs.
„ *catus* (6)	3–7 „	1–10 „
„ „ (7)	3–7 „	1–10 „
Cynælurus jubatus (9)	? „	1–10 „
Cryptoprocta ferox (10)	3–7 „	1–8 „
Viverra civetta (12)	2–7 „	1–8 „
„ „ (13)	4–7 „	1–7 „
„ „ (14)	3–7 „	1–8 „
Genetta tigrina (16)	4–7 „	1–9 „
„ „ (17)	2–7 „	1–6 „
„ *vulgaris* (18)	3–7 „	1–7 „
Herpestes griseus (24)	1–7 „	1–8 „
Proteles cristatus (25)	1–7 „	1–8 „
Hyæna striata (26)	3–7 „	1–8 „
„ „ (27)	2–7 „	1–8 „
„ „ (28)	2–7 „	1–8 „
„ *crocuta* (29)	3–7 „	1–8 „
Canis familiaris (31)	4–7 „	1–7 „
„ „ (39)	? „	1–7 „
Ursus maritimus (45)	3–7 „	1–10 „
„ *americanus* (50)	2–7 „	1–10 „

Procyon lotor (53)	3–7 C. V.	1–7 ribs.
,, ,, (54)	2–7 ,,	1–7 ,,
Nasua (XXXIX.)	1–7 ,,	1–9 ,,
Cercoleptes caudivolvus (61)..	2–7 ,,	1–8 ,,
,, ,, (62)..	2–7 ,,	1–9 ,,
Galictis barbara (64)	4–7 ,,	1–8 ,,
Mustela putorius (65)	3–7 ,,	3 (?)-6 ,,
,, *foina* (66)	2–7 ,,	1–8 ,,
,, ,, (67)	3–7 ,,	1–8 ,,
Ictonyx lybica (70)	3–7 ,,	1–8 ,,
Meles taxus (72)	3–7 ,,	1–8 ,,
Lutra vulgaris (74)	3–7 ,,	1–7 ,,
,, ,, (76)	2–7 ,,	1–7 ,,
,, ,, (79)	2–7 ,,	1–7 ,,
,, *cinerea* (78)	2–7 ,,	1–7 ,,

From this list it would appear that in the Felidæ and Ursidæ the costal attachment is most extensive, while in the Mustelidæ it is least so.

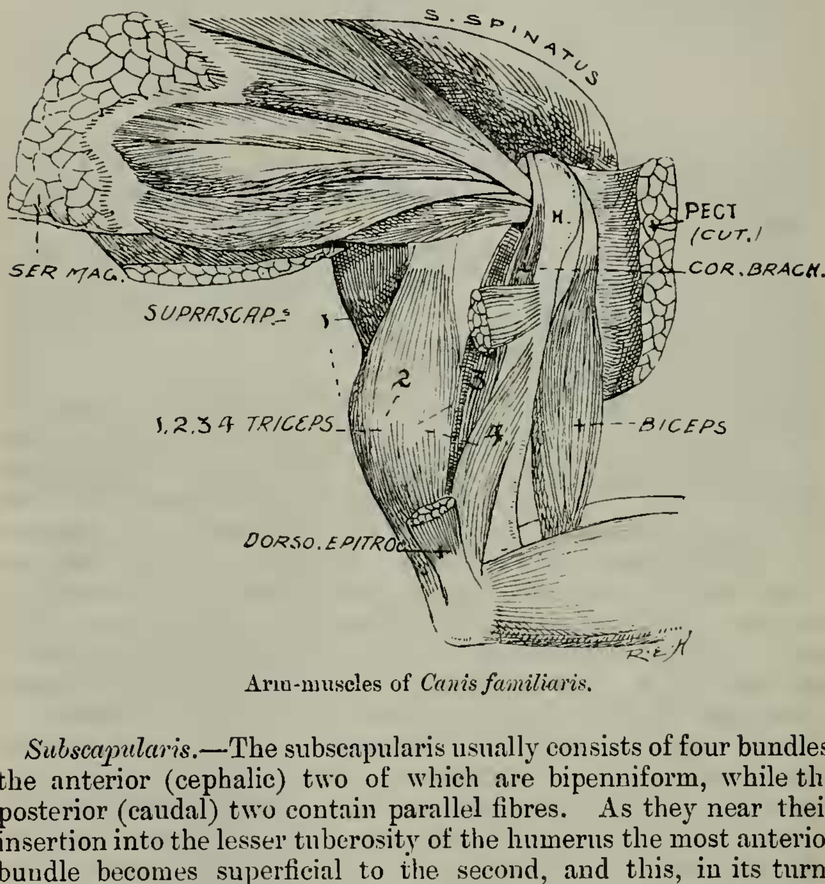
Deltoid.—This muscle consists of the usual three parts—clavicular, acromial, and spinous. The former blends with the ventral portion of the trapezius to form the cephalo-humeral or levator humeri, and is inserted into the lower half of the humerus or the bones of the forearm.

In the Felidæ the insertion seems to be into the forearm, at least this is the case in *F. leo* (1 *a*, 2) and *F. catus* (6). Among the Viverridæ the insertion is also into the forearm in *Cryptoprocta* (10), *V. civetta* (13), *Genetta* (17, 18), and *Herpestes* (24). In Young's specimen of *V. civetta* (VIII.) the muscle was inserted into the lower end of the humerus. In *Proteles* (25) the insertion is also into the forearm. Among the Hyænidæ the muscle is inserted into the humerus in *H. striata* (26) and *H. brunnea* (30), into the forearm in *H. striata* (28). Among the Canidæ it goes to the humerus in *Canis familiaris* (31), to the forearm in *Lycaon pictus* (44). In the Ursidæ its insertion is into the humerus in *U. maritimus* (45) and *U. americanus* (49, 52). Among the Procyonidæ it goes to the humerus in *P. lotor* (53, 54) and *Cercoleptes* (61). In the Mustelidæ it is also usually inserted into the humerus; this is the case in *Galictis barbara* (64), *Mustela putorius* (65), *M. foina* (67), *Ictonyx zorilla* (69), *Lutra vulgaris* (74, 79), and *Lutra cinerea* (78). In *Ictonyx lybica* (70) the insertion is into the lower end of the humerus as well as into the forearm bones.

From this it will be seen that in the Felidæ and Viverridæ the normal insertion of the first part of the deltoid or cephalo-humeral is into the forearm. In the Ursidæ, Procyonidæ, and Mustelidæ it is into the lower end of the humerus, while in the Canidæ and Hyænidæ it may go into either. The acromial and spinous parts of the deltoid are inserted into the middle of the humerus, the acromial lowest, the spinous just above and deep to it.

Supra- and *Infra-spinatus*.—These muscles always rise from the dorsal parts of their respective fossæ and are inserted into the great tuberosity of the humerus. The former muscle is usually the larger and considerably overlaps the cephalic border of the scapula (see fig. 8). In *Herpestes griseus* (24) some of its fibres are continued into the deep part of the pectoral. Macalister (IX.) found the supra-spinatus of *Viverra civetta* divided into two parts, prescapular and spinous, but this arrangement has not been recorded again.

Fig. 8.



Arm-muscles of *Canis familiaris*.

Subscapularis.—The subscapularis usually consists of four bundles, the anterior (cephalic) two of which are bipenniform, while the posterior (caudal) two contain parallel fibres. As they near their insertion into the lesser tuberosity of the humerus the most anterior bundle becomes superficial to the second, and this, in its turn, superficial to the third. The fourth or most posterior bundle is very distinct and rises from the axillary border of the scapula ventral to and continuous with the origin of the teres major, by whose nerve it is supplied. Haughton (XXI.) describes this part in the Black Bear as an infraspinatus secundus, but says that it may belong to the subscapularis (see fig. 8).

Teres major.—The teres major rises from the axillary border of the scapula in its dorsal third; as has been pointed out, its origin is continued towards the glenoid cavity by the fourth bundle of the subscapularis. It is inserted into the anterior surface of the latissimus dorsi tendon and occasionally, as in the case of one specimen of *Ursus americanus* (49), *Viverricula malaccensis* (15), and *Nasua* (60), gives off the dorso-epitrochlearis.

Teres minor.—This muscle is sometimes very closely fused with the infraspinatus, sometimes fairly distinct. We are not inclined to lay any stress on this condition, since it varies in different specimens of the same animal; moreover, that which to one observer would be fairly distinct might be indistinct to another. Meckel (XXXIX.) says that the teres minor is absent as a distinct muscle in most Carnivora. In the following animals the muscle is described as distinct:—*Felis leo* (1), *F. catus* (6), *Cryptoprocta* (10), *Viverra civetta* (12, 13), *Genetta* (18), *Hyæna striata* (26), *Hyæna crocuta* (29), *Canis familiaris* (31, 39), *Lycaon pictus* (44), *Ursus maritimus* (45), *Procyon lotor* (53), *Galictis barbara* (64), *Mustela putorius* (65). In the following animals the teres minor was inseparable from the infraspinatus:—*Proteles* (25), *Hyæna striata* (28), *Ursus americanus* (49), *Procyon lotor* (54), *Cercoleptes* (61), *Lutra vulgaris* (74), and *Lutra cinerea* (78). To these must be added the animals on which Meckel founded his generalization and probably many of those in which no mention is made of the muscle.

Biceps cubiti.—In by far the greater number of Carnivora this is a single-headed muscle, the Ursidæ, as will be seen, forming a marked exception. When only one head is mentioned it is the one from the top of the glenoid cavity which passes through the shoulder-joint. In the following animals the biceps had only one head:—*Felis leo* (1, 1*a*), *F. tigris* (3), *F. catus* (6, 7, 7*a*), *F. caracal* (8), *Cynælurus jubatus* (9), *Cryptoprocta* (10, 11), *Viverra civetta* (12, 13), *Genetta* (16, 16*a*, 17, 18), *Paradoxurus* (19, 21), *Herpestes* (24), *Proteles* (25), *Hyæna striata* (26, 28), *Hyæna crocuta* (29), *Canis familiaris* (31, 34, 35, 36, 37) (see fig. 8, p. 390), *Canis aureus* (42), *Lycaon pictus* (44), *Canis vulpes* (42), *Ursus americanus* (50), *U. arctos* (47) (on left side), *Procyon lotor* (54, 55), *P. cancrivorus* (57), *Nasua* (58, 59, 60, XXXIX.), *Galictis vittata* (63), *Mustela putorius* (65), *M. foina* (66), *Ictonyx* (69, 70), *Meles taxus* (71, 72, 73), *Lutra vulgaris* (74, 76), *L. cinerea* (78). In describing the biceps of the Civet both Macalister (IX.) and Young (VIII.) speak of the single head as rising from the coracoid process. We found the same arrangement in *Herpestes* (24), but were convinced that this head corresponds not to the short but to the long one of human anatomy; our chief reason for this is that it passes through the shoulder-capsule and bicipital groove.

In the following animals a second head was found rising from the coracoid process with the coraco-brachialis: *Paradoxurus* (20), *Ursus maritimus* (45, 46), *Ursus arctos* (47) (on right side), *Ursus americanus* (48, 49, 52), *Procyon lotor* (53) (very feebly marked), *Cercoleptes* (61, 62). The insertion is, in most cases, into the radius only, though in the Hyænidæ it is described as going to the radius and ulna. As a rule, there is very little insertion into fascia, though Shepherd describes a strong bicipital fascia in

Ursus americanus (XX.), which is interesting, because that animal has a two-headed biceps and also because in the specimen of *Procyon lotor* dissected by us (53) the small coracoid head could be separated by a little tearing from the rest of the muscle and was found to end in the fascia of the forearm. So far as we are able to generalize from the material at our disposal, we should say that in the Carnivora a single-headed biceps inserted into the radius is the normal arrangement, but that the Ursidæ are characterized by a double-headed muscle, a condition that is approached by the nearly related Procyonidæ, e. g. *Procyon lotor* (53) and *Cercoleptes* (61, 62).

Coraco-brachialis.—This muscle usually rises by a small rounded tendon from the tip of the minute coracoid process; it soon becomes fleshy to be inserted into the humerus near its surgical neck, having passed above (over the cephalic border of) the latissimus dorsi tendon (see fig. 8, p. 390). This coraco-brachialis brevis or rotator humeri was the only part of the muscle seen in the following animals:—*Feles leo* (1, 1 *a*), *F. tigris* (3), *F. pardus* (5), *F. catus* (6), *F. caracal* (8), *Cynælurus jubatus* (9), *Cryptoprocta* (10), *Viverra civetta* (12, 13, 14), *Genetta* (16), *Paradoxurus* (21), *Herpestes* (24), *Proteles* (25), *Hyæna striata* (26, 28), *H. crocuta* (29), *Canis familiaris* (31) (in four other dogs Macalister describes the coraco-brachialis as present, but does not say which parts; he would probably have made a note had there been anything more than the rotator humeri), *Canis aureus* (41), *Procyon lotor* (53, 54, 55), *P. cancrivorus* (57), *Nasua* (58, 59, 60, 60 *a*), *Cercoleptes* (61), *Galictis vittata* (63). In Straus-Durckheim's cat a delicate tendon rose with the rotator humeri and passed down ventral to the latissimus dorsi to be inserted into the lower third of the humerus just above the supra-condylar foramen (II.). In four specimens of *Ursus americanus* (48, 49, 50, 52) a coraco-brachialis longus was present in addition to the rotator humeri; in one of these Shepherd (XX.) describes the long part of the muscle as being pierced by the musculo-cutaneous nerve, while, in another, Testut (XXIII.) mentions that the brevis was double. In a fifth specimen of the same animal Haughton (XXI.) describes the rotator humeri and then speaks of a coraco-brachialis accessorius, "which," he says, "is like the gemelli"; whatever may be the exact meaning of his description, it is evident that more than one part of the muscle was present in his case. Both *Ursus maritimus* (45) and *U. arctos* (47) resemble the rest of the Bears in having both the brevis and the longus. The Procyonidæ, as has been shown, usually have the normal carnivorous arrangement, but Perrin's specimen of *Cercoleptes* (62) differed from our own in having the bear-like double muscle. Among the Mustelidæ, *Galictis barbara* (64) and *Mustela foina* (67) are bear-like. In four specimens of *Lutra vulgaris* (74, 75, 76, 77) the muscle was entirely absent, while in a fifth described by Haughton (XXXIV.) no mention is made of it, though all the surrounding muscles are spoken of. In *Lutra cinerea* Macalister (XXXVII.) describes the brevis as being present on the left side but absent on the right. In two specimens of *Ictonyx*

(69, 70) the muscle was also absent, as was the case in *Mustela putorius*. In *Meles* (71, 72) the coraco-brachialis is a single muscle and is inserted into the middle third of the humerus, ventral to the insertion of the latissimus dorsi. Unfortunately no mention is made of the relation of the muscle to the musculo-cutaneous nerve, but it looks very much like the only instance of a coraco-brachialis medius which we have met with in Carnivora.

Brachialis anticus.—In its typical arrangement this muscle seems to consist of two parts: (1) a long head rising from the back of the surgical neck of the humerus and winding round the outer side of that bone to reach the front, forming in its passage the musculo-spiral groove; (2) a short head rising from the anterior border of the lower half of the humerus. These two heads are inserted together into the coronoid process of the ulna. In the Carnivora the long head is always present and is most constant in its attachments, while the short head we have not met with at all. We believe that the proper nerve-supply of the long head is the musculo-spiral and that of the short head the musculo-cutaneous; in two or three Carnivora, in which we have carefully looked for this point, we have only found a branch from the musculo-spiral, but further observation is necessary before a definite statement can be made.

Triceps.—This muscle shows a good deal of variation in the number of bundles into which the humeral portion is divided, though we are not inclined to regard these divisions as of any classificatory importance; as an example of this we may quote the case of the Racoon, of which we have three records. In the first of these (53) we were able with great ease to distinguish five heads, the external of human anatomy being double, while the part of the internal head which rose from the bridge of bone over the supracondylar foramen was separate. On comparing this with Allen's description (XXVI.) we find only four heads mentioned, the one from the supracondylar bridge not being distinct. In *Procyon cancrivorus* (57) only the three heads described in Man were noticed. The middle or long head, with one exception, is quite constant and usually rises from the glenoid half of the axillary border of the scapula. Among the Felidæ there are altogether five heads in *F. catus* (6). In the Viverridæ, *Cryptoprocta* is described as having four heads by Beddard (VII.), but in our own specimen we noticed an extra scapular head rising from the dorsal part of the scapular spine and from the fascia over the infraspinatus. In *Viverra civetta* (13) and *Herpestes* (24) four heads were seen, in two specimens of *Genetta* five (16) and four (18) respectively. In *Proteles* (25) Watson found five heads, one coming from the spine of the scapula and probably corresponding to the spinous head in *Cryptoprocta*. Among the Hyænidæ only three heads were seen in *H. striata* (26), but in *H. crocuta* (29) there were four, the external head being double. Among the Canidæ, we found five heads in *C. familiaris* (31), the long head being double (see fig. 8, p. 390); the same arrangement is figured by Cuvier and

Laurillard (XIX.). In the Ursidæ there are three heads in *U. maritimus* (45), four in *U. americanus* (49). Among the Procyonidæ, *Procyon* has already been alluded to. *Cercoleptes* (61) has four heads. The Mustelidæ are remarkable for having an extra head, rising from the angle of the scapula and joining the rest of the muscle in the lower part of the arm, to be inserted into the inner side of the olecranon. This head was noticed in *Galictis vittata* (63), *G. barbara*[1] (64), *Mustela putorius* (65), *M. foina* (66), *Ictonyx lybica* (70), *Meles taxus* (72), and *Lutra vulgaris* (74, 75, 76). The insertion of the triceps is into the upper internal and external surfaces of the olecranon process.

Anconeus.—This muscle is large and triangular and is always closely connected with the lower part of the triceps: its base rises from the back of the external condyle and supracondylar ridge, while the truncated apex is inserted into the outer side of the olecranon process. The muscle is evidently present in all the Carnivora, and only varies in size and in the degree of its fusion with the triceps.

Epitrochleo-anconeus (Anconeus internus).—The epitrochleo-anconeus is a most constant muscle in Carnivora. It is described by Gruber in a good many animals besides those in our list. It is a round muscle which passes from the back of the internal condyle to the inner side of the olecranon, lying superficial to the ulnar nerve by which it is supplied.

Pronator radii teres.—This muscle rises from in front of, and just above, the internal condyle and passes obliquely to the side of the radius farthest from the ulna. There is never any sign of a deep head. The position of the insertion of the muscle seems to be of some interest from a systematic point of view. In the Felidæ it is inserted about the middle of the radius in *F. leo* (1 *a*), *F. tigris* (3), and *F. catus* (6). In *Cynælurus*, Ross (IV.) describes it as reaching to within 2 inches of the lower end, and from its insertion a small tendinous prolongation extends to the palmar fascia. In the Viverridæ the insertion is rather variable; in *Cryptoprocta* (10), *Viverra civetta* (12), and *Hemigalea* (XI.) it goes to the lower half, while in *Viverra civetta* (13), *Genetta* (17, 18), and *Herpestes* (24) it goes to the middle. In *Proteles* (25) it is very small and is inserted about the middle. Among the Hyænidæ, *Hyæna striata* (26, 27, 28) and *H. crocuta* (29) closely resemble *Proteles*. In the Canidæ the muscle is small and is usually inserted above the middle of the radius; this is the case in *Canis familiaris* (31, 39), *C. aureus* (41), and *C. vulpes* (42), while in *Lycaon pictus* (44) it goes to the middle. In the Ursidæ we have records of three specimens of *Ursus americanus* (48, 49, 52) and one of *U. arctos* (47); in all of these the insertion was into the lower end of the radius. Among the Procyonidæ it went to the middle of the radius in three specimens of *Procyon* (53, 54, 57), but Meckel describes it as going to the lower end of the bone in that animal (XXXIX.).

[1] *Vide* description of Dorso-epitrochlearis on p. 386.

In *Nasua* (58, 60, 60 *a*) and *Cercoleptes* (61) it also goes to the lower end. In the Mustelidæ the usual insertion is into the lower end of the bone; at least this is the case in *Galictis barbara* (64), *Ictonyx zorilla* (69), *I. libyca* (70), *Meles taxus* (72), and *Lutra vulgaris* (74, 75, 76): on the other hand, it is attached to the middle in *Mustela putorius* (65), *M. foina* (66), and *Lutra cinerea* (78).

It will thus be seen that in the Felidæ, Viverridæ, Hyænidæ, and Canidæ the insertion of the pronator radii teres is usually into the middle of the radius or, in the Canidæ, above that point, while in the Ursidæ, Procyonidæ, and Mustelidæ its insertion is more often into the lower end.

Flexor carpi radialis.—This muscle, as usual in Mammals, is very constant; it rises from the internal condyle and is inserted into the base of the second metacarpal bone. The following are the only variations with which we have met in its attachments. In *Cynælurus* (9) Ross (IV.) describes slips to the styloid process of the radius and to the trapezium. In *Ursus americanus* (50), Testut (XXIII.) found it ending in the scapholunar. In *Ursus arctos* (47), Meckel (XXXIX.) notices its insertion into the 1st and 2nd metacarpal bones.

Palmaris longus.—The palmaris longus in Carnivora is sometimes double; when this happens we shall speak of an externus and internus. The former is the more constant and is closely connected with the flexor sublimis digitorum at its origin; it spreads out in the palm to form the palmar fascia, and often has definite tendons running to the vaginal sheaths of the proximal phalanges. The palmaris longus internus appears to be a delamination from the flexor carpi ulnaris, and ends in the fascia over the pisiform bone.

Among the Felidæ the externus alone is present. In *Felis tigris* (3) it ends in five definite tendons, one for each digit. In *F. leo* (1) and *F. pardus* (4) Macalister describes a palmaris accessorius which rises from the main tendon a little above the wrist and is inserted into the pads over the 4th and 5th digits; we find a similar muscle figured in Cuvier and Laurillard's plate of the lion's manus (V.), and in our opinion it is the same thing that we describe later under the name of flexor brevis digitorum manûs.

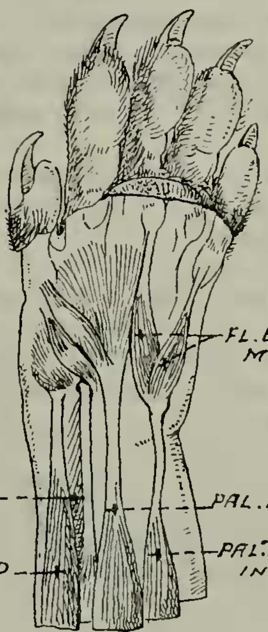
Among the Viverridæ the externus and internus were present in *Cryptoprocta* (10), *Genetta* (18) (see fig. 9, p. 396), and *Viverra civetta* (12). In *Herpestes* (24) (see fig. 10, p. 404), *V. civetta* (14), and *Paradoxurus* (21) the externus alone was present, while in *V. civetta* (13) and *Genetta* (17) the internus was the only part found.

In *Proteles* (25) the externus is distinct from the flexor sublimis digitorum, and there is no internus.

Among the Hyænidæ the arrangement is the same in *Hyæna striata* (26, 28) and *H. crocuta* (29), but in Meckel's specimen of the former animal (27) the muscle was closely blended with the flexor sublimis digitorum.

In the Canidæ we have records of seven specimens of *Canis familiaris*; in four of these the muscle is absent altogether (31, 35, 36, XLIV.), in one (34) a trace was found, while in the remaining two (37, 39) the externus was fairly well developed. In *C. aureus* (41) it was absent, but was found in *C. lagopus* (42). Among the Ursidæ we have records of five specimens: in three of these (46, 51, 52) the external muscle was present, though closely connected with the flexor sublimis; in two (48, 49) it was absent altogether. In the Procyonidæ there are four records of *Procyon*, in three of which (53, 54, 57) both the externus and internus were present; in the other (55) only the externus was found. In *Nasua* (60) the palmaris longus is large, but there is apparently no

Fig. 9.



Manus of *Genetta vulgaris*, showing double palmaris longus and fl. br. dig. manûs.

internus. In two specimens of *Cercoleptes* (61, 62) both externus and internus were present, and it was noticed that the latter was in close connection with the flexor carpi ulnaris and was supplied by the ulnar nerve. Among the Mustelidæ the internus alone is present in *Galictis barbara* (64), while in *Mustela putorius* (65), *M. foina* (66), *Ictonyx zorilla* (69), *I. libyca* (70), and four specimens of *Lutra vulgaris* (74, 75, 76, 79) a large externus alone was found. In *Lutra cinerea* (78) both externus and internus were present, the latter being regarded by Macalister as part of the flexor carpi ulnaris. The summing up of the above results is as follows:—The Felidæ and Hyænidæ always have a palmaris longus externus only. The Mustelidæ usually have the same arrangement. The Viverridæ are very variable. In the Canidæ the palmaris longus is usually absent altogether. In the Ursidæ it is often so. In the Procyonidæ both p. l. externus and internus are usually present.

Flexor sublimis digitorum.—In looking through the literature of carnivorous myology one finds this muscle sometimes described as rising from the internal condyle and giving slips to the flexor profundus, at other times as coming off from the surface of the profundus itself. The method of description seems to depend chiefly on whether the flexor sublimis exceeds in size the condylar origins of the profundus or *vice versâ*. The description which seems to us most applicable to the whole order is that the sublimis rises in common with the condylo-ulnaris head of the profundus from the internal condyle. The insertion is, as usual, into the middle phalanges of a variable number of digits; before its attachment a loop passes round the subjacent profundus tendon in exactly the same way that has been already noticed in Rodents (XLI. p. 266); the sublimis tendon then splits and allows the profundus to pass through it. The number of digits into which the tendons of the sublimis are inserted varies a good deal, and seems to bear no relation to the position of the animals in the order. By far the commonest arrangement is to find the tendons inserted into the second, third, and fourth digits; this occurs in the following animals:—*Viverra civetta* (12), *Cryptoprocta* (11), *Genetta* (17), *Herpestes* (24), *Proteles* (25), *Hyæna striata* (27), *H. crocuta* (29), *Canis familiaris* (39), *Procyon lotor* (53, 55), *P. cancrivorus* (57), *Nasua* (60), *Cercoleptes* (61), *Mustela putorius* (65), *M. foina* (66), *Ictonyx zorilla* (69), *I. libyca* (70), and *Lutra cinerea* (78). In the following animals tendons go to the first, second, third, and fourth digits, the pollex being counted as the first; *Ursus americanus* (48), *Procyon lotor* (54), and *Nasua* (58). In *Ursus americanus* (49) and *Felis catus* (6) slips are given to all five digits. In *Lutra* (76), *Genetta* (16), and *Canis* (31) there were tendons to all the digits except the thumb. In *Cryptoprocta* (10), *Ursus maritimus* (45), *Meles* (72), and *Lutra* (74) the muscle only gave off two tendons to the third and fourth digits respectively. In *Hyæna striata* (26) tendons passed to the third, fourth, and fifth digits.

Flexor carpi ulnaris.—This muscle consists of two parts, condylo-pisiform and olecrano-pisiform, the former rising from the internal condyle, the latter from the olecranon process. In certain cases these two heads are quite distinct from their origin to their insertion, but more usually they unite in the forearm, leaving a gap for the ulnar nerve to pass between them as in Man. Laurillard (XXII.) has suggested that possibly the double arrangement is characteristic of young animals, the single of older ones, but we have not come across any facts which bear out this theory. Among the Felidæ the two parts join in the upper part of the forearm in *Felis catus* (6), while in *F. leo* (1) (æt. 8 years) and *F. tigris* (3) they unite in the lower quarter. In the Viverridæ the two parts remained distinct until their insertion in Macalister's and Devis's specimens of *Viverra civetta* (13, 14), in *Cryptoprocta*

(10), and *Genetta* (17), but they fused high up in the forearm in *Viverra civetta* (12), in *Genetta* (18), *Herpestes* (24), and *Proteles* (25). Among the Hyænidæ the head from the olecranon was absent in *H. striata* (27) and *H. crocuta* (29), but in *H. striata* (26) both heads were present and joined high up. Among the Canidæ we have records of the dissection of this muscle in six specimens of *C. familiaris* (31, 32, 34, 36, 37, 39), in one of *C. aureus* (41), in *C. lagopus* (42), and in *Lycaon pictus* (44). In all these nine animals the two parts were distinct. Among the Ursidæ we unfortunately have records of only two specimens (49, 52), but in both of these the muscle was double. In the Procyonidæ the two heads are distinct in *Procyon lotor* according to Allen (54), but united in our experience (53). In *Nasua* (60) and *Cercoleptes* (61) they are fused. Among the Mustelidæ the two parts unite high up in *Mustela putorius* (65) and *Ictonyx* (70). In *Lutra vulgaris* (76) they join about the middle of the forearm, while in *L. cinerea* (78) and *Meles* (71, 72) they remain distinct. The insertion of both parts is usually into the pisiform bone, but in *H. striata* (26) expansions are continued to the four metacarpals, while in Testut's specimen of *Ursus americanus* (50) the tendon passed the pisiform and was inserted into the fifth metacarpal. Both bellies of the flexor carpi ulnaris are supplied by the ulnar nerve.

Flexor profundus digitorum.—In a former paper (XLV.) one of the authors has described this muscle as consisting of five primary parts, condylo-radialis, condylo-ulnaris, centralis, radialis, and ulnaris; so that when the typical arrangement is present there are three origins from the internal condyle as well as one each from the radius and ulna. It is difficult to be quite sure in all cases which of these parts were really present, since different authors have adopted different methods of description, but in most instances the arrangement is evident enough. Among the Felidæ all the heads are present in *F. catus* (6, XLV.). In the Viverridæ all five origins are present in *Cryptoprocta* (10), *Genetta* (16, 16 *a*, 18), *Paradoxurus* (19, 20), *Viverricula malaccensis* (15), and *Cynictis penicillata* (XLV.), while in *Herpestes nepalensis* (23), *H. griseus* (24), and *Viverra civetta* (13) the centralis was absent. In all these animals there is a slip to the pollex as well as to the other four digits. In the Hyænidæ it is not possible to say which elements of the muscle were present. In *Hyæna striata* (26) Young found no slip to the pollex, though Meckel describes a small one in his specimen of the same animal (27); in *H. crocuta* (29) the pollex slip was also absent. It is interesting to notice that, so far as the pollex tendon goes, *Proteles* (25) agrees with the Viverridæ rather than with the Hyænidæ. Among the Canidæ, Windle found all the heads present and distinct in the dog (XLV.). In Cuvier and Laurillard's dog (39) the centralis is apparently wanting. In another dog which we dissected (31) the condylar heads were fused into one broad origin from the internal condyle, though we are inclined to think that the centralis was not combined with this. Krause[1] also does not notice the centralis in the dog. Among the Ursidæ, Windle notices the absence of the condylo-ulnaris in *Ursus americanus* (48), while in two other specimens of the same animal (49, 52) only one condylar origin is described. In the Procyonidæ all five heads were found in *Procyon lotor* (53), *P. cancrivorus* (57), *Nasua rufa* (XLV.), and *Cercoleptes* (61). In Perrin's specimen of *Ceroleptes* (62) the centralis was not noticed. In the Mustelidæ all five heads were present in *Mustela putorius* (XLV.), *Ictonyx zorilla* (69), *Meles* (XLV.), *Lutra vulgaris* (XLV., 74), and *L. cinerea* (78), while in *Galictis vittata* (63) and, apparently, *M. putorius* (65) the centralis was absent[2].

From the foregoing details it will be seen that in the Carnivora it is usual to find all five origins of the flexor profundus digitorum, that the condylo-centralis is the part most frequently missing, and, after that, the condylo-ulnaris. The two specimens of Hyænidæ were the only animals in which the muscle did not send slips to all five digits.

Lumbricales.—As a rule there are four of these muscles, but when there are less it seems that the one on the radial side disappears first and the ulnar one next. In the following animals four muscles were found:—*Felis catus* (6), *Viverra civetta* (12), *Genetta* (16), *Herpestes* (24), *Hyæna striata* (27), *H. crocuta* (29), *Ursus maritimus* (45), *U. americanus* (49), *Procyon lotor* (53), *Nasua* (60), *Cercoleptes* (61), *Meles* (71, 72), and *Lutra* (76). In the following there were three lumbricales:—*V. civetta* (13) (ulnar one absent), *Proteles* (25), *Canis familiaris* (31) (radial absent), *Mustela putorius* (65) (radial absent), *Lutra vulgaris* (79) (radial absent), and *L. cinerea* (78) (radial absent). In *Hyæna striata* (26) and *Ictonyx libyca* (70) only the two middle lumbricales were present.

Pronator quadratus.—This muscle is always present in the Carnivora and is usually of considerable thickness when cut through. The part nearest the carpus is always the thickest, strongest, and most persistent. The muscle may extend for the whole length of the bones or may only occupy a fraction of them at their carpal ends. Among the Felidæ the pronator quadratus almost always occupies the lower half of the forearm; this is the case in *Felis leo* (1), *F. tigris* (3, XXIII.), *F. pardus* (4), and *F. catus* (6). In *Cynælurus* (9), however, it seems to occupy rather more than half. In the Viverridæ the muscle is very variable. In *Cryptoprocta* (10) it is attached to the lower $\frac{2}{3}$. In *Herpestes nepalensis* (23), *H. griseus* (24), one specimen of *Paradoxurus* (19), and *Viverricula malaccensis* (15) it is present in the lower half; in *Genetta* (16), *Viverra civetta* (12), and the second specimen of *Paradoxurus* (20) in the lower third; in *V. civetta* (13) in the lower quarter. In *Hemigalea* Mivart (XI.) describes

[1] 'Anat. des Kaninchens.'

[2] It should, however, be borne in mind that the centralis is very easily overlooked.

it as being very large, and says that it is inserted into the plate-like process of the radius. In *Proteles* (25) it resembles the same muscle in the Hyænidæ and is attached to the whole length of the bones. Among the Hyænidæ it occupies the whole length of the forearm in *Hyæna striata* (26, 27) and *H. crocuta* (29). In the Canidæ all writers agree in saying that the pronator quadratus of the dog occupies the whole length of the forearm, and we have verified the statement (31). The same arrangement is found in *Canis aureus* (41), *C. vulpes* (42, XXIII.), *C. lupus* (XXIII.), and *Lycaon pictus* (44). Among the Ursidæ the muscle only occupies the lower third of the forearm in *Ursus arctos* (47) and *U. americanus* (48, 49, 50, 51). In the Procyonidæ it was found in the lower two-thirds in *Procyon lotor* (53) and *P. cancrivorus* (57), but Allen (XXVI.) describes it as occupying half the forearm in the former animal (54). In *Nasua* (58, 60 *a*) and *Cercoleptes* (61) it was only present in the lower third, though Perrin (XXIX.) describes it as taking up the lower two-thirds in the latter. Among the Mustelidæ the muscle occupies the whole forearm in *Mustela putorius* (65); the lower half in *Galictis vittata* (63), *Lutra cinerea* (78), and *L. vulgaris* (74); the lower third in *Meles* (71) and *Ictonyx* (70). From the foregoing it will be seen that in the Felidæ the pronator quadratus is attached to the lower half of the ulna and radius, in the Canidæ and Hyænidæ to the whole length, in the Ursidæ to the lower third, while in the Viverridæ, Procyonidæ, and Mustelidæ it is variable.

Supinator longus.—This muscle rises from the external supracondylar ridge of the humerus for a variable extent, in some cases reaching as high up as the surgical neck; it is inserted into the radial side of the lower end of the radius. Among the Felidæ it is present in *Felis leo* (1), *F. tigris* (3), *F. pardus* (4, XXXIX.), *F. catus* (domestic) (6, 7, 7 *a*), *F. catus* (wild) (XXXIX.), but in *Cynælurus* (9) it was not found. In the Viverridæ it was found in *Cryptoprocta* (10), *Viverra civetta* (12, 13), *V. malaccensis* (15), *Genetta tigrina* (16), where it sends an expansion to the dorsal carpal ligaments, *G. tigrina* (17), *Paradoxurus typus* (19, 20), *Herpestes nepalensis* (23), and *H. griseus* (24). In *Hemigalea* (XI.) it is also present and is attached to the plate-like process of the radius. In *Proteles* (25) it is absent. Among the Hyænidæ it is absent in *H. striata* (26, 27, 28), and is a mere vestige in *H. crocuta* (29). With regard to the Canidæ we have had some little difficulty in following the accounts of other writers. The muscle is certainly absent in the following four dogs: 31, 34, 36, 38. In one specimen (37) it was absent on the left, rudimentary on the right. In another specimen (35) it only weighed 1·07 grs., and must therefore have been very feebly marked.

In a dog described by Haughton (32) the muscle is said to be present, but he states that there is only one extensor carpi radialis, which is inserted into the little and ring fingers; in this case we cannot help suspecting that the muscle described by him as supinator longus was really the other extensor carpi radialis. In *Lycaon* *pictus* (44) Pagenstecher says that the "supinator brevis is absent, as in the cat and dog"; in this instance supinator longus, not brevis, must surely have been meant. There can, we think, be little doubt that in the Canidæ the muscle is usually absent. In the Ursidæ the supinator longus is very constantly present; it is so in four specimens of *Ursus americanus* (48, 49, 51, 52), and one of *U. maritimus* (45), of which we have records. In the Procyonidæ it is present in three specimens of *Procyon lotor* (53, 54, 55), in *Nasua* (60), and *Cercoleptes* (61). Among the Mustelidæ it is present in *Galictis vittata* (63), *G. barbara* (64), *Mustela putorius* (65), *M. foina* (66), *Ictonyx libyca* (70), and *Meles taxus* (71, 72). In four specimens of *Lutra vulgaris* the muscle was found to rise from the humerus as far up as the neck (74, 75, 76, 77); it was also present in *L. cinerea* (78).

To sum up, the supinator longus is present in the Felidæ with the exception of *Cynælurus*, the Viverridæ, the Ursidæ, the Procyonidæ, and the Mustelidæ. It is usually absent in the Hyænidæ with which *Proteles* agrees, and in the Canidæ.

Extensor carpi radialis longior and *brevior*.—The point on which the greatest stress is laid in descriptions of these muscles is as to whether they are completely separate or more or less blended at their origin. We are not inclined to pay much attention to this distinction, since it has frequently been our lot to find muscles, apparently inseparable, separate easily with a little traction. The origins of the muscles are the same as those described in human anatomy, the longior rising from the supracondylar ridge, the brevior from the condyle. The insertions are respectively into the shafts of the metatarsal bones of the second and third digits. The following are the only variations with which we have met:—In *Hyæna striata* (26, 27) the two tendons are united by a transverse band about the level of the wrist. In *Lutra cinerea* the extensor carpi radialis longior divides, and one part is inserted on each side of the base of the second metacarpal, the inner one being connected by a transverse slip with the tendon of the extensor carpi radialis brevior.

Extensor communis digitorum.—This muscle rises from the back of the external condyle, and is inserted into the middle and distal phalanges of the second, third, fourth, and fifth digits; on the dorsum of the hand the tendons are connected by broad, thin vincula. This insertion is most constant in all the Carnivora, the only exceptions with which we have met being a dog (32) dissected by Haughton, where the tendons are described as going chiefly to the fourth and fifth digits, and our own specimen of *Herpestes* (24), where the slip to the fifth digit was wanting.

Extensor minimi digiti.—This muscle rises from the external condyle and, in the dorsum of the hand, usually divides into three tendons which pass to the medius, annularis, and minimus, uniting on the backs of the digits with the expansions of the extensor communis. In the following animals tendons to these three digits were present:—*Felis tigris* (3), *F. catus* (6), *Cryptoprocta* (10, 11), *Viverra* *civetta* (12, 13), *Genetta* (16), *Herpestes* (22, 24), *Canis familiaris* (31, 38, 39), *Ursus arctos* (47), *U. americanus* (48, 49, 51, 52), *U. maritimus* (45), *Procyon lotor* (53), *P. cancrivorus* (57), *Nasua* (60, 60 *a*), *Cercoleptes* (61), *Galictis vittata* (63), *Mustela putorius* (65), *M. foina* (66, 67), *Meles* (71, 72, 73), and *Lutra* (74, 75, 76, 77, 78, 79). In the following animals tendons were only supplied to the annularis and minimus:—*Felis leo* (1), in which the extensor minimi and the extensor quarti digiti are separate muscles and lie in distinct sheaths, *Genettta* (17), *Herpestes* (23), *Proteles* (25), *Hyæna striata* (26), *H. crocuta* (29), and *Canis aureus* (41). In *Ictonyx libyca* (70) two tendons were found, but these went to the medius and annularis. In *Cynælurus* (9) Ross describes only one tendon to the second phalanx of the fifth digit, but he says that there is also an " extensor minimi digiti tertii " rising from the upper fifth of the radius and passing through a separate sheath of the annular ligament to the 1st phalanx of the minimus (IV.).

Extensor carpi ulnaris.—This muscle has the human attachments and is extremely constant. The only point of interest which we have come across is that Meckel (XXXIX.) describes it as double in the White Bear; it must be borne in mind, however, that in the Bears the flexor carpi ulnaris is double, so that there may be some confusion between the two muscles.

Supinator brevis.—This consists, as in most mammals below the Primates, of one layer, which lies superficial to the posterior interosseous nerve; it rises from the orbicular and external lateral ligament, and in some cases reaches as high as the external condyle. It is inserted into the outer side of the radius, reaching a greater distance in some animals than in others. In the Felidæ our records of this muscle are very scanty, but it seems usually to occupy the upper third of the forearm. In the Viverridæ it occupies the upper third in *Cryptoprocta* (10) and *Genetta* (18); in *Viverra civetta* (12, 13) it is merely described as well marked, while in *Herpestes* (22, 24) it was found in the upper two-thirds of the forearm. In the Hyænidæ it seems to be only slightly developed (26, 28, 29), and Watson (XIII.) does not mention it at all in his description of *Proteles*. In the Canidæ, Meckel (XXXIX.) describes it as occupying the upper half of the forearm, but in other specimens (31, 39) it did not extend so far down. The Ursidæ are remarkable for the great development of the supinator brevis; in *Ursus maritimus* (45) it reaches to within $1\frac{1}{2}$ inches of the lower end of the radius, while in *U. americanus* (48, 49, 52) it occupies the upper two-thirds to three-quarters. Among the Procyonidæ it covered the upper half of the radius in *Procyon lotor* (53, 56) and *Nasua* (60), the upper third in *P. lotor* (54) and *Cercoleptes* (61). Allen (XXVI.) describes it as being pierced by the posterior muscular branch of the musculo-spiral nerve (posterior interosseous ?), an arrangement which was not present in our specimen of *Procyon* and which we have never seen in any other Carnivore. In the Mustelidæ the length of the muscle varies. Macalister describes it as well marked in *Galictis barbara*

(64), while in *Mustela putorius* (65) and *Lutra* (74, 77, 78) it reaches as low as the third quarter. In *Meles* (72, 73), however, it only goes as far as the middle of the radius.

Extensor ossis metacarpi pollicis.—This muscle is always present in Carnivora and is constant in its attachments: it rises from the dorsal surfaces of the radius and ulna, especially the latter, and is inserted into the base of the metacarpal bone of the pollex and often into the radial sesamoid bone near it. In *Procyon lotor* (53) and *Galictis barbara* (64) slips were given to the trapezium. In the former animal and in *Viverra civetta* (12) the highest fibres rose as far up as the olecranon.

Extensor digitorum profundus.—Instead of describing the extensor secundi internodii pollicis and extensor indicis as two separate muscles, we have found it more convenient to follow the example set in Bronn's 'Thierreich'[1] and to speak of them under the above heading. We do not propose to include the extensor ossis metacarpi pollicis with the other two, as it is not an extensor of a digit but of a metacarpal bone. The extensor primi internodii we have never seen in the Carnivora. The origin of the extensor profundus is from the dorsal surface of the ulna, below that of the extensor ossis metacarpi pollicis, as well as, sometimes, from the dorsal surface of the radius. In the Felidæ the muscle goes to the pollex and index as a rule; this is the case in *Felis leo* (1), *F. tigris* (3), *F. pardus* (4), and *F. catus* (6). In *Cynælurus* (9), however, no slip goes to the index. Among the Viverridæ the insertion is very constant and is the same as it is in most of the Felidæ: *Cryptoprocta* (10), *Viverra civetta* (12, 13), *Viverricula malaccensis* (15), *Genetta* (16), *Paradoxurus* (19, 20), and *Herpestes* (24). In *Proteles* (25) it is inserted into the third digit only. Among the Hyænidæ there is no tendon for the aborted pollex; in *Hyæna striata* the muscle went to the third digit only in Meckel's specimen (27), to the second and third in Cuvier and Laurillard's (28), and to the second, third, and fourth in Young's (26). In *H. crocuta* it went to the second only. The Canidæ resemble the Hyænidæ in the feebleness of the slip to the pollex. Out of three specimens of *Canis familiaris* it went to the first and second in one (37); to the second, with a very feeble slip to the pollex, in another (31); and to the second digit only in a third (39). In *C. aureus* (41) Macalister found an extensor secundi internodii, but no extensor indicis, while in *C. lagopus* (42) a very feeble extensor indicis alone was present. Among the Ursidæ, Windle and Shepherd found no index slip in *Ursus americanus* (48, 49), but in Cuvier and Laurillard's specimen (52) it went to the pollex and index. In *U. arctos* (47) and *U. maritimus* (45) it had the same insertion. Among the Procyonidæ the muscle is more constant; it goes to the first and second digits in *Procyon lotor* (53), *P. cancrivorus* (57), *Nasua* (60, 60 *a*) (in the former (60) the two muscles were quite distinct as far as their origin), and in *Cercoleptes* (61). In two other specimens of *P. lotor* (54, 56) the insertion was into the pollex, index, and

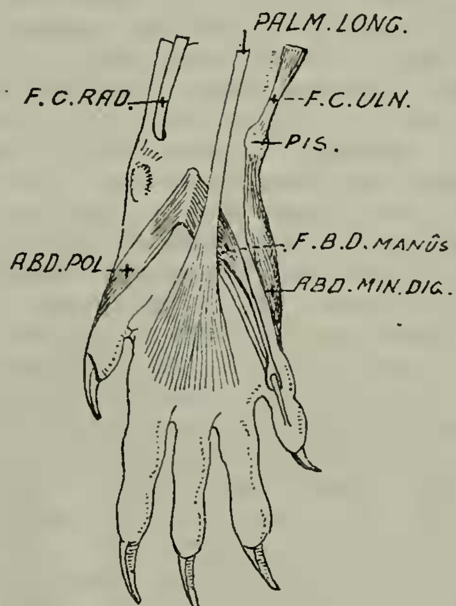
[1] Sechster Band, V. Abtheilung, 37–39 Lieferung, p. 816.

medius. Among the Mustelidæ the muscle is very constant, being inserted into the first and second digits in *Galictis vittata* (63), *Mustela putorius* (65), *M. foina* (66), *Ictonyx zorilla* (69), *I. libyca* (70), *Meles* (71), *Lutra vulgaris* (74, 76), and *L. cinerea* (78). In Haughton's specimen of *L. vulgaris* (79) the insertion was into the second and third digits.

Muscles of the Hand.

Flexor brevis digitorum manûs.—When this muscle is present in the Carnivora it rises from the annular ligament, pisiform bone, and palmar fascia, and occasionally from the lower part of the palmaris longus tendon. It is inserted into the vaginal sheath of the minimus, or, if it is more fully developed, forms the flexor perforatus of that digit. Among the Felidæ the muscle was

Fig. 10.



Manus of *Herpestes griseus*, showing single fl. br. dig. manûs.

present in *F. leo* (1 *a*), and apparently in Macalister's specimens of *Felis leo* (1) and *F. pardus* (4), though in these it went to the fourth and fifth digits. In the Viverridæ it was present and formed the flexor perforatus tendon to the minimus in *Viverra civetta* (12), *Herpestes* (24) (see fig. 10), and *Genetta* (17). In *V. civetta* (14) and *Genetta* (18) it ended in the vaginal sheath, and, in the latter animal, went to the fourth and fifth digits (see fig. 9, p. 396). Among the Hyænidæ it was present in *Hyæna crocuta* (29), but not in *H. striata* (26, 28). We have no records of it among the Canidæ or Ursidæ, and it was certainly absent in our specimen of *Canis familiaris* (31). In the Procyonidæ it seems very constant; it is present in *Procyon lotor*

(53, 54, 55) and *P. cancrivorus* (57). In *Nasua* (60) it is figured by Cuvier and Laurillard, and, in all these animals, seems to end in the sheaths of the tendons. In *Cercoleptes* (61, 62) it forms the flexor perforatus of the little finger. In the Mustelidæ it seems to be usually absent, or at all events very feebly marked; the only record we have of it in this family is in *Mustela putorius*.

Palmaris brevis.—The palmaris brevis is apparently never present in Carnivora.

Thenar Muscles.—This group consists of the abductor, flexor brevis, and opponens of human anatomy. Among the Felidæ the only record we have is of the Cat (6), in which the abductor rises from the trapezium and annular ligament; the usual double-headed flexor brevis is present, and the opponens very small. From our experience of the rest of the muscles of the Felidæ we presume that the other animals of the family closely resemble the Cat in their thenar muscles. In the Viverridæ, we found a weak abductor and a well-marked flexor brevis in *Cryptoprocta* (10). In *Viverra civetta* (12) and *Viverricula malaccensis* (15) the same muscles were found, though Devis (X.) describes an opponens in addition in *Viverra civetta* (14). In *Paradoxurus typus* (19, 20) and *Herpestes griseus* (24) the abductor and flexor brevis alone were found.

In *Proteles* and the Hyænidæ there were no thumb-muscles. Among the Canidæ we only found two muscles of the thumb in *Canis familiaris* (31), one going to the inner, the other to the outer sesamoid bone (see fig. 11, p. 406). It is difficult to determine whether these should be looked upon as two heads of a flexor brevis or as an abductor and adductor. The muscles were small and the nerve-supply somewhat difficult to be quite certain of, but we are of opinion that the radial muscle was supplied by the median, and the ulnar by the ulnar nerve. We are further led to regard the latter muscle as an adductor pollicis by the fact that Cunningham (XLVI.) describes an adductor in the Dingo. The radial of the two muscles rises from the trapezium and is therefore probably an abductor, so that in the Dog a slender abductor pollicis is present, but no opponens or flexor brevis. Among the Ursidæ, Kelley (XXIV.) only mentions a flexor brevis pollicis in *Ursus maritimus* (45). Meckel (XXXIX.) describes the thenar muscles as very strong in *U. arctos* (47), the abductor in his specimen had two origins, from the trapezium and base of the first metacarpal; there was in addition a flexor brevis. In *U. americanus* (49) there were also abductor, flexor brevis, and opponens. Among the Procyonidæ, *P. lotor* (53, 56) has an abductor and flexor brevis, while *P. cancrivorus* (57) has a small opponens besides. *Cercoleptes* (61, 62) has an abductor, flexor brevis, and small opponens. Among the Mustelidæ, Alix (XXX.) describes a superficial and deep abductor pollicis in *M. putorius* (65); probably these correspond to our abductor and flexor brevis. In *M. foina* (66) the same two muscles exist, as they do also in *Ictonyx* (69, 70) and *Lutra vulgaris* (74). In *Lutra cinerea* (78) a small opponens was found by Macalister.